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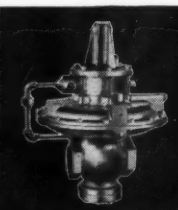
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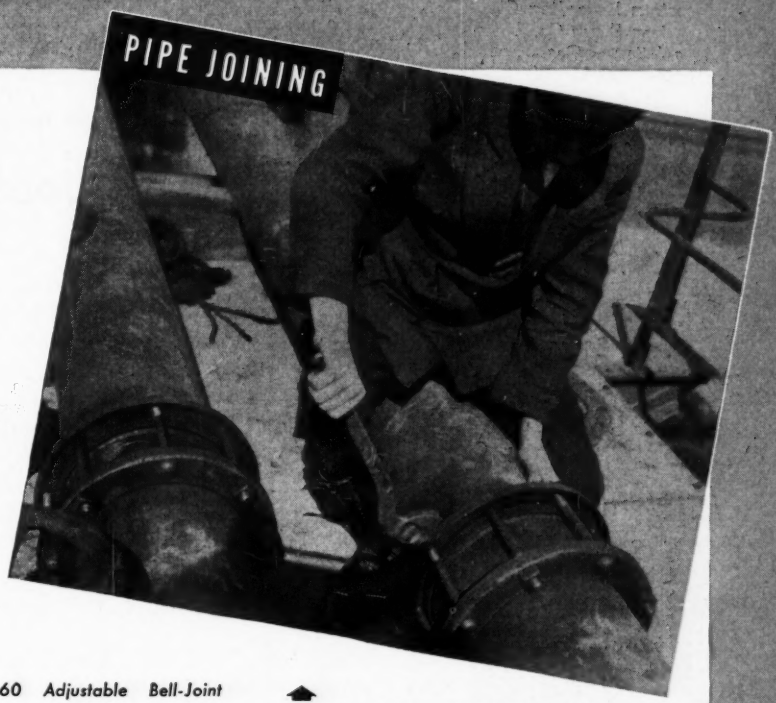

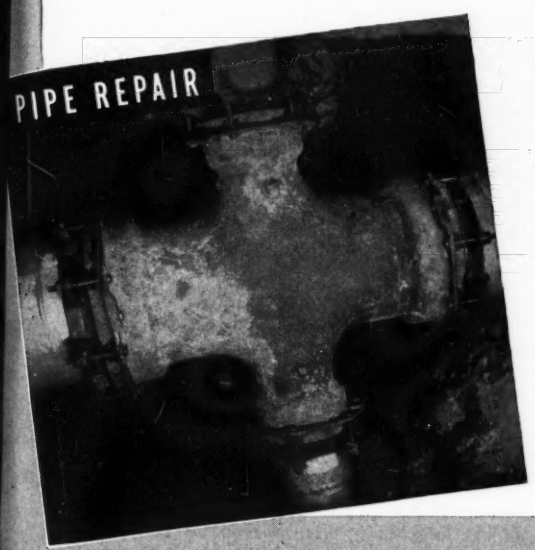

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Thermally Thinking

By ELLIOTT TAYLOR, Washington Editor

Chemical Realism

WE believe that one of the most significant and timely studies that GAS has ever had the privilege of presenting is the paper by James E. Pew and Frank H. Dotterweich (page 14) discussing the new potentialities of gas as a chemical raw material, with a consideration of the possible effect of the new demands for basic hydrocarbons on the gas-fuel economy of the nation.

The gas industry, in common with many others, has watched with interest and anticipation the new developments that the past decade has brought in the field of synthetic products. Prior to the start of our preparations for the present war, the subject of new plastics received the lion's share of attention. For here under the magic of molecular rearrangement, were created materials that had never existed in the world before, materials in some instances with physical properties so unique that experiments in their adaptation to practical products are still in their infancy. As the monstrous calamity of war finally engulfed our nation, we became increasingly preoccupied with developing our new chemical techniques in refining and developing new instruments of destruction. Superfuels for super bombers, and new explosives to bring new and unprecedented havoc to our enemies became overnight our major preoccupation. Synthetic rubber emerged from the test tube and novelty stage and became the savior of our mechanized way of life. Even plastics were hastily drafted into the role of substitutes for strategic and critical metals; and uses developed under the urge of arch necessity now appear destined to continue in times of peace.

But as romantic and stimulating to the imagination as these developments have been, there have been moments when they have loomed as matters of grave future concern to the natural gas industry as a whole. For while natural gas may be potentially one of the greatest, if not the greatest source of chemical hydrocarbons, the whole economy of its utilization has been built up on the basic concept of gas as primarily a fuel, source of heat and of energy. As is pointed out by the authors, Pew and Dotterweich, "The stability of the gas industry and, more particularly the natural gas section, has been built around a numerically substantial domestic load, which condition has permitted it to weather the storms of depression." Those who have expressed misgivings as to the ultimate impact of the Fischer-Tropsch process on gas distribution and utilization have had in the back of their minds the fear that these new chemical demands might bring to an untimely end the expansion of natural gas for historic fuel purposes.

To the extent that a carefully documented scientific analysis of a problem can be used in making predictions for an unpredictable future, we believe that the study here presented establishes for the first time the probable quantitative relationship between natural gas as the fuel of the future, and as the source of raw materials for ultimate chemical rearrangement.

When we consider the fact that the 1943 estimated production of synthetic organic chemicals could have been derived from the ethane, propane and butane content of but 75% of the amount of natural gas reported lost and wasted during 1941, there seems little reason to fear that the post-war extension of natural gas into markets and for fuel uses that are economically feasible will be restricted by the presently foreseeable demands of chemistry.

Psychological Tactics

THERE is a desperate and growing need throughout the country for the return of a more substantial portion of industry to the manufacture of civilian goods, among which we place on a high priority our own gas ranges, and water heaters. A few weeks ago there was every reason to hope that the WPB would authorize some increases in production of these and other household items that are currently falling into states of disrepair that border on the hazardous.

Such hopes as industry entertained have been since dissipated, however, by repeated announcements that the army and navy have blocked all return to civilian production until the coming invasion of Europe has been successfully established. If the army and the navy need the output that would be represented by the materials thus withheld from normal consumption, we have no quarrel with their decision; nor would we have them abate by a pound the amounts of munitions that they consider a safe minimum for a successful offensive action.

But another and equally persistent story goes the rounds, and you hear it from officers in uniform as often as you hear it from the keyhole kings who purport to tell you not only what Washington is doing and going to do, but also what it thinks and is going to think—if it does. The army in particular seems to have elected itself not only to the position of high command of the military forces but to that of custodian and moulder of public psychology as well. And it is said that one reason why civilians have to be denied further the small comforts and conveniences that conceivably could now be made available, is that they "haven't had the war brought home to them" with sufficient force.

Since every penny a line writer thinks he is a master of military strategy, it is probably only to be expected that the general staff would like to take a fling at some department outside of its field of specialized training. It is notorious that once the army gets in the saddle it immediately assumes that it alone is competent to do all of the planning, whether or not that planning has any particular bearing on the military campaigns under its jurisdiction.

We admit that the military should and must be the final authority on what materials are needed, and when, and where; and it must have first claim on stock piles,

on production capacity and on the manpower necessary to put them there. But as amateur psychologists, seeking to mould public opinion on the outmoded "privation is good for you" premise that Leon Henderson took with him when he got out of OPA, the generals and the secretaries are fighting out of their class.

Our unmoulded public opinion on military matters is that all the citizens of a democratic state want of their army is that it go out and win, and come home and disband. As far as we can see, little punitive expeditions into realms of mass psychology serve to advance neither of those paramount objectives.

Draft Replacements

IF the advice is still timely enough to be of any use by the time we get it into print, we recommend that the gas companies, and particularly the smaller systems, revamp their manpower replacement schedules bringing them up to date with the realities of the new WMC policies on occupational deferments.

From a practical standpoint, the army and navy demands between now and July 1st will just about require every physically fit man between the ages of 18 and 26 regardless of his family status. The group from 26 to 37 will also be hit hard, but there seems at present a possibility that some consideration will be given the requests for occupational deferments for fathers and those others in the age group possessing critical skills in essential production.

We appreciate that essential occupations in the gas industry have been in a large measure in the hands of oldsters, particularly for the past three years; but we are also advised that the OWU is concerned with what appears to be an attitude of complacency in utility management regarding the new inroads that the draft is going to make on its manpower.

It is pointed out that a temporary deferment of an employee subject to the draft is not in any sense intended to mean that he is released from his obligation for military service, but merely that he has been reprieved long enough to break someone else in on his job. For every man now occupied in an essential post on a six months deferment there should be, theoretically, another man (or woman) not subject to draft, preparing to take over his job.

E. Holley Poe, Missing in Inaction

THE somewhat abrupt resignation of E. Holley Poe as executive vice-president of the Petroleum Reserves Corporation seems to have come as more of a surprise to Secretary Ickes than it did to the executive officer's friends and associates in the natural gas industry, and from what little we have seen on the surface the self styled curmudgeon did not take his assistant's departure with very good grace.

Holley Poe is a natural gas man, and so long as he was in charge of the Natural Gas and Natural Gasoline Division of PAW he was moving in a familiar element, doing business with people who understood his language, and who deferred to his judgment when their immediate self interest had to be made strictly secondary to national welfare. The division that he organized and staffed became and still remains one of the smoothest functioning agencies in Washington, with his one-time associates carrying on the same policies in much the same spirit that was engendered by his leadership.

Transferred from his position, where his capacities and talents were finding effective utilization, and where the policies were clear cut and definite, he was thrown into the mysterious maw of the Petroleum Reserves Corporation, where he early found that there was neither use nor respect for his ability, and from which, despite his efforts, there has never yet issued anything that even approximated a statement of policy.

It is quite conceivable that had his recommendations for a frank and open statement of an American petroleum policy been heeded, the PRC might not now have been faced with the possibility of an untimely demise at the hands of congress. And public opinion might have been able, in some degree at least, to judge the $15,000,000 Arabian pipeline deal on the basis of its merits, instead of in the welter of claims and accusations that are being made for and against it.

Competent natural gas executives are not in such abundance that they can be wasted in Washington, and whatever the PRC may lose through the want of an imposing front man for its unpredictable deals, we do not feel that the loss will be disproportionate to the industry's gain in the return of Holley Poe to natural gas ranks.

Suspect Advice

AN Ohio oil executive has been allowing himself the luxury recently of deploring in the public prints the wanton wastefulness of using natural gas for practically any operation except domestic usage. We have been gradually coming around ourselves to the viewpoint that dump load sales of gas for boiler firing and other purposes where an inferior fuel would serve, will one day be regarded as undesirable except to the extent and the degree that they are necessary to maintain an economical load factor on major transmission systems.

But we question whether the most disinterested advice and counsel on the subject will stem from either the oil or coal industry. It might be hard for a high executive there to divorce entirely his consideration of the greatest public good from the contemplation of the fat killing that he could make in a competition-free market.

Anyone who would invoke the imposition of additional artificial restraint on the gas industry should be prepared to accept with composure the application of the same principle to his own enterprise. If we are to accept the premise that industry is congenitally unable ever to decide what is best for it, or for its patrons, then we should wholeheartedly endorse a still further extension of the present practice of a detailed ordering of our daily affairs. And to advocate restriction of the extension of any fuel strictly by the end uses to which it is put, is to advocate the adoption of a scheme whereby all fuels are assigned to prescribed and strictly limited functions.

The road of regimentation has little allure for the oil industry, as it has amply demonstrated in times past. And those who have no desire to travel the highway themselves are ill advised to point out its advantages to others.

The End of an Era in UTILITY RATE FIXING

By WILLIAM A. DOUGHERTY

Attorney at Law, New York City

I. Utility regulation from "Smyth vs. Ames" to the Natural Gas Pipeline Case.

ON March 7, 1898, the Supreme Court of the United States, responding to the argument of William Jennings Bryan, acting as counsel in the case, decided *Smyth* vs. *Ames*, 169 U. S. 466. Thereupon began a period of rate regulation of public service enterprises under a rule recognizing that the Constitution of the United States guaranteed to investors, who had devoted their property to the public use, a fair return on the property serving the public. The measure of that return was related to the fair value as of the time of the inquiry. When the rule was announced it was at the behest of the public authorities, because investment figures were considered to be watered and wasteful and much greater than the reasonable value of the property at the time. The Great Commoner urged that a decline in values should be suffered by a railroad, just as it was by the farmer whose grain it hauled. The merits and demerits of that rule have been the cause of much writing, discussion and controversy. Under its protection the utility industry of this nation has grown into a successful, well operated enterprise, rendering service to the people at lower rates and in a better manner as time marched on.

It was not until after the first World War that the controversy over this rule developed into one of sharply drawn division of contention. When the Federal Power Commission became an influencing factor in rate regulation it started a movement among many State Utility Commissions to eliminate fair value and to substitute an investment basis as the measure of determining compensation which investors should receive. The Commission's first attempt to obtain modification of this rule was in the case of *Railroad Commission* vs. *Pacific Gas and Electric Company*, 302 U. S. 388, decided in 1938. In that case the Court sustained the California Railroad Commission's findings —based primarily on cost—because of the peculiar circumstances involved.

The next opportunity which the Federal Power Commission seized was in the case of *Driscoll* vs. *Edison Light and Power Company*, 307 U. S. 304. But here again the Court refused to set aside the fair value rule, and Mr. Justice Frankfurter suggested in a concurring opinion that needless additional strength had been given to it. It was not until cases arising under the Natural Gas Act arose that the Federal Power Commission had its first direct opportunity to put into effect its rate making theories.

In the first case coming to the United States Supreme Court involving the rate making powers under the Natural Gas Act, there was the first indication that the fair value rule was on the way out. The case involved the *Natural Gas Pipe Line Company of America* (315 U. S. 575) which is the pipe line supplying the Chicago area from the Panhandle Field. There it was definitely stated by the Court that the "Constitution does not bind rate-making bodies to the service of any single formula or combination of formulas." The Court proceeded to approve an interim order of the Commission which, however, was based on the Company's testimony of the fair value of the property. This case did not clearly settle the fair value controversy because this pipe line was built in a period of prices comparable to those at the time of the rate investigation, and no great general change in price levels was involved. It was thought that there still might be a chance of having the Court recognize fair value where the property under regulation had been constructed during periods of low prices before the first World War and costs could not be the same thing as value today.

WILLIAM A. DOUGHERTY has been actively connected with the natural gas utility and pipe line industry for 10 years. In 1933 he became connected with the natural group of Standard Oil Company (New Jersey) devoting his time to legal matters of those companies. Previous to that he was engaged in the practice of law in Cleveland, Ohio. During Mr. Dougherty's connection with Standard Oil Co. he devoted considerable time to the problems arising in connection with the preparation by Congress of the Public Utility Holding Company Act and was directly connected with much of the legislative history of the Natural Gas Act.

W. A. Dougherty

He has been counsel in a number of rate cases before State Commissions and the Federal Power Commission. Coincident with the segregation of the natural gas utility subsidiaries of Standard Oil Co. through the organization of Consolidated Natural Gas Co., Mr. Dougherty resigned from Standard Oil Co., and on January 1 of this year established his own offices for the practice of law.

He is General Counsel for Consolidated Natural Gas Co., of which Hope Natural Gas Co. is a subsidiary, and also for Colorado Interstate Gas Co., Mississippi River Fuel Corp. and Interstate Natural Gas Co., Inc.

II. The Hope Natural case brings an end to 46 years of fair value regulation.

The answer came on January 3, 1944, when the Supreme Court in the *Hope Natural Gas Company* case ended all speculation on this point. After 46 years of fair value rate regulation the prophecies embodied in the *Natural Gas Pipe Line* case have been realized. Not only is the Commission free to use any formula or method it chooses, but unless the utility can show in some undetermined way that the result is arbitrary, unjust and unreasonable, there is nothing to justify relief.

A re-reading of the Black-Douglas-Murphy concurring opinion in the *Natural Gas Pipe Line* case discloses it as the source of the Douglas opinion in the *Hope* case. With the concurrences of Mr. Justice Rutledge and Chief Justice Stone, the concurring opinion of the *Natural Gas Pipe Line* case became the law of the land for cases arising under the Natural Gas Act and all public utility cases coming from State Commissions on the basis of constitutional confiscation.

The rule now in force is found in a few sentences, but in that limited space effective judicial revue of the Federal Power Commission became extinct, for no yardstick is there

stated by which the end result may be tested. These are the words:

> It is not theory but the impact of the rate order which counts. If the total effect of the rate cannot be said to be unjust and unreasonable, judicial inquiry under the act is at an end. The fact that the method employed to reach that result may contain infirmities is not then important.

The majority opinion also states:

> Congress, however, has provided no formula by which the 'just and reasonable' rate is to be determined. It has not filled in the details of the general prescription of § 4 (a) and § 5 (a). It has not expressed in a specific rule the fixed principle of 'just and reasonable.'

In making this pronouncement the Court has done nothing more than to emulate the Congress, for no light is thrown on how one may test a rate. It is said that the process "involves a balancing of the investor and the consumer interests." There must be enough revenue to pay operating expenses and the capital costs. That is about all that can be relied upon. If bond interest is met and some dividend paid on the stock, then all else is of no consequence. Little wonder that Mr. Justice Jackson says:

> The Court sustains this order as reasonable, but what makes it so or what could possibly make it otherwise, I cannot learn.

Again he comments:

> If we are to hold that a given rate is reasonable just because the Commission has said it was reasonable, review becomes a costly, time consuming pageant of no practical value to anyone.

The Court has reviewed the financial history of the Hope Company, and that seems to be all that has been considered in the final analysis. Mr. Justice Jackson again comments on this action as follows:

> The Court does lean somewhat on considerations of capitalization and dividend history and requirements for dividend on outstanding stock. But I can give no real faith to that, for it is generally and I think deservedly in discredit as any guide in rate cases.

Coming to Mr. Justice Frankfurter, he disagrees that the Natural Gas Act gives such final control to the Commission, pointing out that the Commission's own determination of what is a just and reasonable rate is not conclusive. He says:

> Otherwise, there would be nothing for a court to review except questions of compliance with the procedural provisions of the Natural Gas Act. Congress might have seen fit so to cast its legislation. But it has not done so.

Mr. Justice Reed disagreed with the view that only the result and not the means by which it is reached is important.

III. No longer is there a government of laws and not of men in the utility field.

Out of this welter of conflict what can the utility investor look to and how can the management judge what is to follow? First, and more important than the end result in this particular case, is the abrogation by the Supreme Court of its constitutional and statutory duties under the Natural Gas Act. Our Government is founded on the principle of a balancing of functions of the Executive, Legislative and Judicial authority. Beginning in 1803 in the case of *Marbury* vs. *Madison*, the Supreme Court has ever since courageously exercised its duty of passing on legislative action both of Congress and of the States, and testing that action by the Constitution. Administrative bodies were held within the "ambit of their statutory authority" and rights of citizens were fully protected. The Constitution had a meaning, and the Courts saw to it that legislative and administrative action conformed. Now the trend of the majority is to abdicate the Court's constitutional duty and responsibility, and to leave nothing except procedural matters of fair play to be examined. No longer is there a government of laws and not of men in the utility field. No standards will be found in the Court opinions, but only in the changing personnel of regulatory Commissions. Whatever the defects of the fair value rule in its administration, there was in the final analysis a principle which could be applied irrespective of the personal opinions of the administrative body. Without any formula within which their acts may be restricted, there is no line of limitation foreseeable in the rules laid down by the Court.

The second conclusion justified by the Hope case is that earnings of public utilities eventually will be reduced to the bare bones. As TIME magazine, in the issue of January 17, 1944, puts it: " * * * the Supreme Court finally shaved off the plush" of utility earnings. *"Through the Wringer"* is the sub-heading used to express what is ahead.

The *Hope* case finds the Court doing what has long been said not to be the rule, i.e. considering past earnings or losses in fixing present rates. See *Galveston Electric Company* vs. *Galveston*, 258 U. S. 388, and *Board of Commissioners* vs. *New York Telephone Company*, 271 U. S. 23. The *Galveston* case was cited by Chief Justice Stone in his opinion in the *Natural Gas Pipe Line* case as a basis for this statement:

> But regulation does not insure that the business shall produce net revenues, nor does the Constitution require that the losses of the business in one year shall be restored from future earnings by the device of capitalizing the losses and adding them to the rate base on which a fair rate and depreciation allowance is to be earned. (Citing cases) The deficiencies may not be thus added to the rate base for the obvious reason that the hazard that the property will not earn a profit remains on the company in the case of a regulated, as well as an unregulated business.

One would seem to be justified in concluding that if the rule is applied in the manner stated by the Chief Justice, then there should be no attempt to cut down present and future rates merely because a company had been successful in the past. But, that is exactly what the Court has condoned in the *Hope* case. The only basis for approving the end result is a review of financial statistics which do not picture the whole history nor the reasons why these financial results have occurred. A penalty has been placed on consecutive, sound, financial practices, and profligate management may now reap the reward that should go to the thrifty.

No consideration is given to the fact that fair value was the rule until January 3, 1944, and that much of the earning history of the Hope Company had been under the fair value principle. Little consideration is given to the full number of dollars invested in *property* from Company cash. Had *Hope* paid out large dividends to its stockholders who in turn would have purchased additional stock, the capitalization of the Hope Company would be twice what it is and all of its stock would have been issued for cash. But because that seemed unnecessary in the early days of the Company's operations, the cash production from the business was plowed back in. Whether or not these dollars were reflected in the books of account as earnings, depreciation reserve or capital is of little consequence. The Court, discussing figures as though the problem before it were one of accountancy, related earnings to invested capital rather than to the dollars invested in property, and tested these past results, not on the basis of rules that would have applied during the past years, but from the viewpoint of the present. Therein lies the fallacy of considering financial results over a period of 40 years in an attempt to determine what are just and reasonable rates today. Six and one-half per cent is approved as the fair rate of return today, but it cannot be used as a criterion of earnings over the past 40 years. Consideration of historical earnings should be

accompanied by consideration of historical rates of return demanded by investors during these past periods.

IV. The effect of the Hope case on the operation and financial integrity of utilities.

Thus has ended an era of rate fixing during which the investor received a return commensurate with the risks, and reflecting the changes in price levels just as if his investment were in an unregulated industry. We cannot now foresee what effect the new rule will have on the operations and financial integrity of utility companies. There have been some statements attempting to minimize the seriousness of the results, it being claimed that the *Hope* case was not a representative one; that *Hope* had been earning an abnormal return over a long period and that its situation was not typical of the utility industry. The error of this conclusion lies in the failure to recognize that public utility earnings in the past have been based on the fair value of its property. That reductions in rates will be attempted is evidenced by the attitude expressed in TIME magazine, referred to above, and by the press release issued by the FPC shortly after the decision in which Chairman Olds indicated that many reductions of electric utility rates would now be possible.

In its application to the natural gas business, the abandonment of the fair value rule has serious implications. Particularly will this be true if the prices of gas sold by producers in the field to interstate pipe lines becomes subject to regulation. The fair market value is now paid for that gas. On the cost or prudent investment theory followed by the Power Commission, no compensation is given for the natural gas itself. Nothing more is permitted to be charged than an amount sufficient to pay for the cost of getting the gas out of the ground. No wonder that the State of West Virginia appeared in the *Hope* case in opposition to the Power Commission's order. No wonder that the States of Louisiana and Texas are beginning to oppose the exportation of natural gas to the industrial areas of the North and East. If Congress permits the Federal Power Commission to require that the natural resources of one State be made available to inhabitants of another State at the mere cost of developing and transporting those resources, then we may expect further and continued opposition to the normal development of the natural gas industry.

Now that the Supreme Court has abandoned any effective judicial review of administrative bodies, the responsibility placed upon the administrators is tremendous. Congress must recognize this fact and decide whether it wishes that responsibility to remain uncontrolled within the administrative body, or whether some means should be provided for a judicial review that will give substance to a litigant's day in court.

Canadian Legislation on Oil, Gas Development

Pipeline Utilities

A bill aimed at making public utilities of pipelines, scrubbing plants and wells for producing or capable of producing natural gas, introduced in the Alberta legislature by N. E. Tanner, minister of lands and mines, was given final reading by the legislature on March 20.

The bill provides for the setting up of a two-man commission of G. M. Blackstock of Edmonton, chairman of the Board of Public Utility Commissioners, and Dr. E. H. Boomer of Calgary, chairman of the Petroleum and Natural Gas Conservation Board and professor of chemical engineering at University of Alberta. A third member could be appointed by order-in-council.

Under the legislation, known as the Natural Gas Utilities Act and set before the legislature in the first week of March, the board is authorized to direct any pipeline or scrubbing plant operator to construct or rearrange pipelines, install compression equipment and other equipment for conserving, gathering and transporting gas. It is also empowered to buy at an agreed price or to expropriate, if producers or processors fail to obey such orders. It may take over and operate a well or levy a penalty of $1000 per day if gas is wasted contrary to board rulings.

The board will determine the prices to be paid for natural gas at the wellhead whether provided for marketing concerns, for field use or for return to formation. It will also determine the prices to be paid by gas marketers for the gas after scrubbing or other processing. The Public Utilities Board, however, will continue to control the prices for gas to be paid by the ultimate consumer of Alberta cities and towns.

The bill is designed to open the natural gas markets of the province to all producers. Contracts carrying exclusive rights are to be rendered null and void, and the board is to see that no contract or agreement in future restricts or reserves the exclusive right to supply natural gas to or for markets available or to become available. One immediate effect will be the ending of the Rovalite monopoly on sale of Turner Valley gas to Canadian Western Natural Gas, Light, Heat & Power Co., and the sharing of this market among all Turner Valley gas producers.

The board is authorized to return to the formation all gas in excess of that required for markets being supplied. It can direct a well owner to tie into the collection system and to continue production of gas if the board deems such production to be in the public interest. Also, the board may require the owner of a gas well to permit his property to be used for the storage of excess gas.

New Petroleum and Gas Act

Natural gas and petroleum development in the Canadian Pacific Coast province of British Columbia, hitherto governed under the Coal & Petroleum Act, is to be brought under a separate act as a result of recent legislation in the province. The bill stipulates that crown natural gas and petroleum can be disposed of only by order-in-council.

The legislature of British Columbia on March 14 passed the Petroleum and Natural Gas Bill by a vote of 24 to 18, despite claims by the official opposition party, the Co-Operative Commonwealth Federation, that the measure was a backward step.

Manner of disposing of natural gas and petroleum is provided by license to prospect, by license to drill, and by lease to produce upon discovery of gas or oil in commercial quantities. All permits and licenses shall be for a one-year period, renewable annually, while leases shall be for 20 years. No permit, license or lease may be transferred without government permission.

Maximum area for location under permit shall be 256,000 acres in rectangular form. A location under license or lease must not exceed two square miles. Surface rights are retained by the crown, operators being permitted to use what is necessary for efficient operations.

Oil royalties are to be 12½% on the gross production, while natural gas royalties will be fixed in the permit, license or lease. Rental on acreage held under permit is to be 5c per acre; the fee for a permit and for renewal of one is $250.

Maximum Hydrocarbon Utilization With
NATURAL GAS AS A CHEMICAL RAW MATERIAL

By JAMES E. PEW and FRANK H. DOTTERWEICH

THE growth of the gas industry during peacetime was accompanied by developments and operating problems primarily related to the use of natural and manufactured gas as a source of fuel and energy. While these activities were being given major attention, a new technology was being evolved—that of Petro-Chem development, in which gaseous hydrocarbons were being distorted, rearranged, and recombined to yield chemical raw materials from which useful products could be manufactured. Today the swift tempo of war activities places increased emphasis upon these Petro-Chem operations, capable of suppyling our tremendous war machine with vital war products, many of which find natural gas as the basic raw material.

The wartime developments are not of a static nature but will progress steadily until the not-too-distant day when a substantial portion of our hydrocarbon derivative chemical products will have their origin in natural gas. In this paper the authors will endeavor to note processes presently available, together with those which will become generally available in the post-war period by means of which we may hope to utilize more efficiently the full range of our hydrocarbon raw material and, in addition, to analyze the effect of these Petro-Chem operations upon present and post-war activities of the gas industry. The future of natural gas in its capacity as a chemical raw material has occupied much space in technical publications and general discussions, and this subject continues to grow in stature. This is true, at least in part, because of the rapidly advancing technologies, which appear destined to have profound effect upon the future of the industries involved. Natural gas is known as the ideal fuel with its superb performance bringing about the development of special heating and cooling equipment and thus furthering the earlier standardized applications, such as cooking and heating.

The stability of the gas industry and, more particularly, the natural gas section, has been built around a numerically substantial domestic load, which condition has permitted it to weather the storms of depression. In looking into the future the question arises as to what effect Petro-Chem developments are to have upon this industry. Naturally this problem resolves itself into, first, an analysis of available natural gas reserves; second, a consideration of the success of new commercial processes proposed with natural gas as their chemical raw material; and, third, a quantitative study of the extent to which the use of natural gas therein will deplete those reserves.

Natural Gas Reserves

Natural gas reserves are today estimated at 110 trillion cu. ft. With marketed natural gas production approximately 3¼ trillion cu. ft. in 1943, a supply sufficient for the next 30 or more years appears to be definitely assured. This compares very favorably with an estimated oil production known reserve ratio of 14 years.

A further evaluation of relative importance of natural gas in the natural resources picture is provided by a comparison of natural gas and oil reserves, on a thermal or weight basis, either of which reveals their near equivalence. Probing more deeply behind these reserves figures, it may be determined that estimates of natural gas reserves have risen phenomenally in less than 10 years. A 1935 estimate of 62 trillion cu. ft. of gas reserves appeared optimistic beside others at that time; yet, in the ensuing nine years, during which more than 25 trillion cu. ft. of gas have been withdrawn from the nation's underground reservoirs, reserves estimates have risen to the present 110 trillion cu. ft. for the nation.

Meanwhile, an analysis of discoveries in the highly active area embracing South Arkansas, Louisiana and the Coastal Plain of Texas reveals further, that in the years between 1934 and 1943, the proportion of gas and gas-condensate to total discoveries rose from 24% to 52%, with gas-condensate discoveries largely uncovered in deeper drilling increasing from 11% to 36% of the total during this period. The continuance and expansion of this deeper drilling program, undertaken as improvements in technique permit, may be expected to uncover an increasing proportion of fields of the gas-condsenate type, existing under extremes of pressure and temperature, and these fields, productive of the lighter hydrocarbon fractions which are proving so valuable in wartime production programs, through the installation of cycling equipment may constitute the nucleus in the post-war period of the new Petro-Chem technology. So much is already evident: the period and magnitude of gas-condensate discoveries is adequate to justify appreciable capital outlay, as increasing amounts of the lighter hydrocarbon materials will be made available for chemical processing and, potentially, manufactured gas enrichment. The latter, gas enrichment with ethane-propane mixtures, should be given immediate attention by manufactured gas companies, if the advantages of a higher Btu. gas of non-gumming and non-corrosive properties are to be attained.

But the gas industry has still greater possibilities ahead. The uses of natural gas to be hereinafter described are new uses, providing new markets. The gas companies possessed of a high degree of engineering skill and knowledge, with a fundamental awareness of the capabilities of their stock-in-trade, could look upon the new technology as an added source of revenue.

It is necessary to emphasize that

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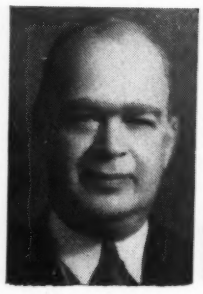

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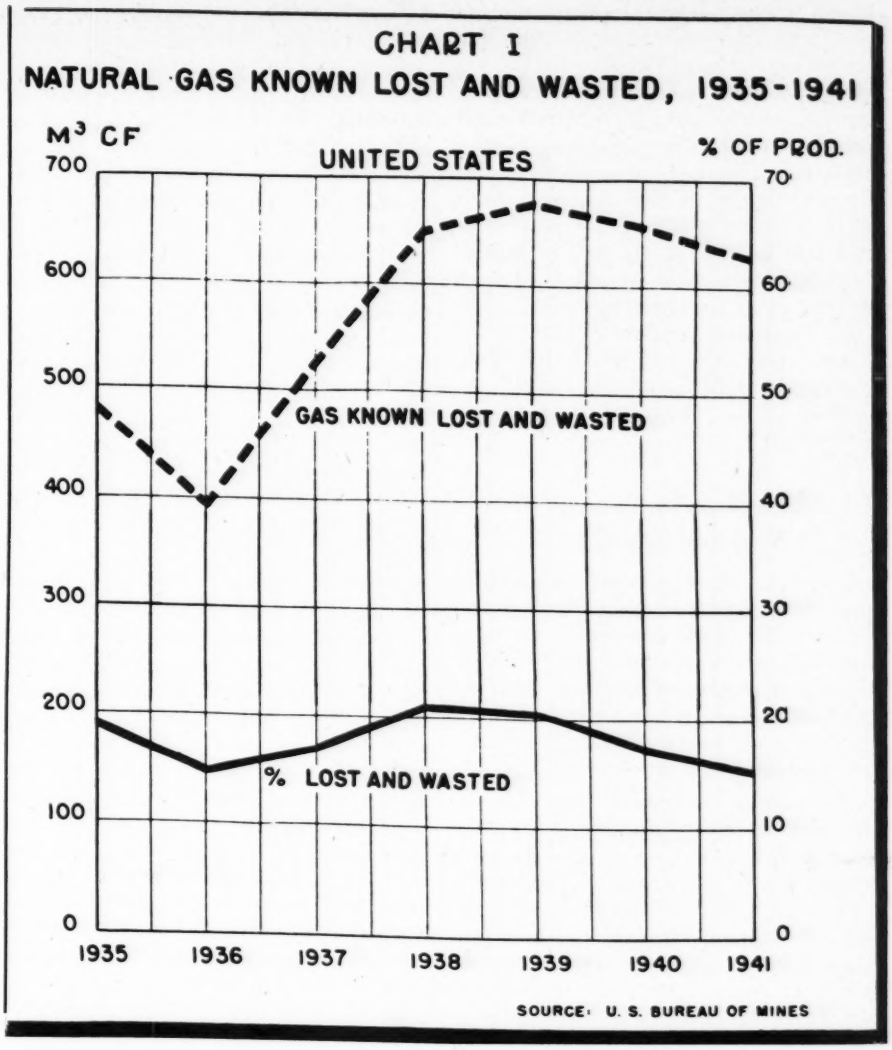
paper was presented under the title, "Maximum Hydrocarbon Utilization with Natural Gas as a Chemical Raw Material," before the Southern Gas Association Convention, New Orleans, La., March 22-23.

the new market created for, as shall be seen, the needs of the United States for certain products in 1943 could have been met through conservation of natural gas reported lost and wasted by the U. S. Bureau of Mines in the 1942 Minerals Yearbook, carrying most recently published analysis of gas disposition (1941). Actual production exceeded 4 trillion cu. ft. with almost one-third of this being divided between repressured and stored gas (660 billion cu. ft.) and gas known lost or wasted (630 billion cu. ft.) The latter figure will be used in the calculation to follow as being both qualitatively and quantitatively indicative of the magnitudes of this waste. Gas loss and waste in proportion to production is decreasing as indicated in Chart 1, but the figure is still far too great, despite the intensified efforts of the governing legislative bodies to reduce it to the absolute minimum.



New and Proposed Commercial Processes

The importance and value of natural gas at present and, in the postwar period, to an ever greater extent, is a measure of the volme available and the low critical material requirement for processing and production. By modern methods of extraction and fractional distillation, natural gas may be separated into relatively pure saturated hydrocarbons, valuable in their pure state as blending agents or, when specially processed, still more valuable as a chemical raw material, giving remarkably high yields of war products. Among these are high octane aviation gasoline, synthetic rubber, explosives and plastics, all being made in great quantities, with petroleum and natural gas as key components. Too, new processes and products are constantly undergoing development, and natural gas will continue to grow in importance as a chemical raw material.

In discussing the newer methods of conversion, not only into the essential raw materials, but also into the final products, it appears desirable to divide these into (1) processes directly concerned with the production of superior liquid fuels from natural gas, and (2) processes concerned with the production of other chemical raw materials.

Liquid Hydrocarbon Fractions from Natural Gas

Such hydrocarbons as propane and butanes occur in appreciable quantities in wet or casinghead gas, and are largely removed before the gas is marketed. At the present time the propane-butane fractions serve as liquefied petroleum gases and also as the feed materials from which certain aviation fuel components are derived. Production of the super aviation fuels, composed of select hydrocarbon fractions in definite proportions, requires large quantities of iso-octane alkylates, cumene, tetraethyl lead, and other essentials. An appreciable amount of these ingredients has its origin in natural gas—in fact, a finished aviation fuel may be produced altogether from fractions obtainable in exploitation of the nation's gas-condensate fields.

The production of liquid hydrocarbon fractions from dry natural gas is presently receiving attention. The processes involved have been developed commercially by European powers and are related to those through which the Axis nations are now synthesizing gasoline from coal. The increasing reserves of natural gas in this country, viewed in conjunction with heightened consumption and decreased finding power of crude oil, are presently accelerating interest on this subject.

In the past, liquid hydrocarbon fractions have been prepared by a process commonly referred to as the Fischer-Tropsch process. In this process, water gas (carbon monoxide plus hydrogen) is the raw material. In Europe water gas has been prepared with coal or coke as the starting raw material. However, with the modern steam conversion process, in which natural gas and steam are made to react to form water gas or hydrogen as an end product, a more reasonably synthesized liquid fraction is available. The importance of the process in relation to America's 110 trillion cu. ft. of gas reserves cannot be over emphasized for it makes natural gas well-nigh competitive with crude oil. Natural gas could possibly be one of the starting raw materials if the crude oil supply is to be supplemented or supplanted in the synthetic hydrocarbon fractions.

With natural gas as the starting raw material, three steps are involved: reforming to water gas, synthesis into liquid hydrocarbon fractions, and recovery and separation. The three are

already being practiced separately on a commercial scale, and the problem resolves itself into "flanging up" these operations and perfecting operating conditions so that this synthetic liquid may be produced on a favorable economic basis. Investigation of the combined processes is now being undertaken in pilot plant operations, with estimates as high as 4.2 gal. of liquid products recoverable per Mcf. of dry natural gas, including fuel gas. This yield if proven practical is approximately equivalent to one barrel of a mixture, (chiefly gasoline, diesel oil, and heavy oil) per 10,000 cu. ft. of dry natural gas.

Chemical Processes— New and Proposed

Chemical developments related to natural gas are numerous, and progress is being made constantly. In this paper major attention is to be directed to the preparation of products derived from natural gas which serve as chemical materials from which many useful products may be derived.

The steam conversion process, to some extent developed in this country, is outstanding because it reforms dry natural gas to water gas or hydrogen. Water gas, in addition to being the base product in the manufacture of liquid fuels may be the starting point in the production of synthetic alcohol and formaldehyde. War and peacetime uses of hvrodgen are many, but chief among them is the production of synthetic ammonia for use in explosives, fertilizers and hydrogenation processes (principally in the production of super fuels).

The regenerative furnace process makes available still another method of cracking natural gas. This furnace, now ready for commercial operations, produces important starting chemical materials, such as acetylene, ethylene and propylene from natural gas constituents, not excluding methane, but with ethane and heavier fractions more desirable. Still another method is provided in the electrical production of acetylene. This method is being thoroughly investigated in pilot plant operations, and may be expected to be of importance in the post-war production of acetylene.

The production of carbon black, of fundamental importance to the rubber, printing and paint industries, has long utilized about one-tenth of this country's annual production of natural gas through the simplest of the chemical reactions into which methane, the principal component of natural gas, enters—combustion and thermal decomposition. Carbon black is today being prepared from natural gas alone in channel and roller plants (typical of contact methods of manufacture), and thermal and furnace plants. A product similar to the furnace type is also being prepared from degraded oil and natural gas in combination. It is interesting to note that the thermal production of carbon black had its origin in the derivation of hydrogen, from natural gas, with the thermal black presenting merely a by-product. It is, then, possible to obtain two products through one process. The production of hydrogen alone is economically feasible, even in areas of high gas cost; the relatively cheap, coarse grade of carbon black obtained, capable of being used in extremely high loadings, represents additional revenue.

Oxidation process is now in commercial operation, with natural gas serving as a raw material in the production of formaldehyde, methyl alcohol, acetone and acetaldehyde, among others. Present processes yield a mixture of these oxidation products, and economics require that the market absorb all of these derivatives if the high cost of production is not to be imposed upon any one end product. It is possible that more recently developed processes now undergoing examination will premit conversion of natural gas exclusively into one product, thus eliminating economic uncertainty. (The subject of producing oxyhydrocarbon derivatives by alternative method is considered elsewhere herein.)

The chlorination of natural gas and its derivates to form chlorhydrocarbon solvents is of proven commercial importance, while their use has been greatly increased in war time. The peacetime uses of these compounds have been greatly curtailed or eliminated in order that they may be made available for war uses. These compounds are of great importance, both in chemical warfare and in the synthetic rubber industry, as well as in many other uses demanding near or absolute non-flammability plus excellent solvent power for oils, fats and other organic materials. Improved processes of this type are continually being developed, and natural gas will remain one of the important raw materials.

The vapor phase nitration of natural gas hydrocarbon on a commercial plant scale basis has produced the four Nitroparaffins: nitro-methane. ethane, propane and butane, thus making available for chemical synthesis a group of compounds with a potential range of usefulness unequaled by any other group of organic chemicals. These compounds are more than just another new group of new compounds because they open an entirely new field of organic chemistry, a field which someday may rival the development of the coal tar derivatives in magnitude and scope. At the present time their entire production is going into essential war uses for the synthesis of pharmaceuticals, dyestuffs, insecticides, rubber chemicals, photographic developers, textile chemicals and resins together wtih their use in solvent applications. The entire postwar industry, particularly the highly specialized industries. should find these nitroparaffins a fertile source of improved and new chemicals for new and better products.

In addition to being of great importance as a raw material in the processes previously cited, natural gas is forging ahead along other lines. An example is the production of carbon disulfide, presently derived by heating sulphur and charcoal. Recently published laboratory research indicates that high yields of carbon disulfide may be obtained through the high temperature reaction of methane and sulphur, and that methane and other hydrocarbons offer possibilities as cheap raw materials in this production, such new processes making use of natural gas as a chemical raw material, are introduced daily.

Quantitative Requirements of Natural Gas in its Capacity as a Chemical Raw Material

Diversified opinions have been voiced regarding the magnitude of demands, which may be made of natural gas in its capacity as a raw material for the rapidly developing Petro-Chem industry. The view most generally held, and one in which the authors have concurred, is that demands will be slight by comparison with the enormous volumes annually used for fuel. An attempt has accordingly been made in the following paragraphs to evaluate these demands quantitatively, based upon production figures for various organic chemicals which were synthsized during 1943. As will be shown, all of these could have been produced with a fraction of the natural gas loss and wastage to which reference was earlier made.

Methane is suitable for the production of acetylene, particularly by electrical methods, and may also be used in the steam conversion process whereby formaldehyde or methanol may be obtained. With these possible exceptions, ethane, propane, and butane provide more desirable raw materials. Accordingly use has been made of

TABLE 1.

Synthetic Organic Chemical	*United States 1943 Production (lbs.)*[1]	*Possible Processes and Raw Materials*		
		Basic Hydrocarbon Raw Material	*Intermediate Hydro-Carbon Raw Material*	*Processes*
Acetaldehyde	224,445,142[2]	Ethane Propane	Acetylene	Regenerative Cracking
Acetic Acid (100%)	264,898,632[2]	Ethane Propane	Acetaldehyde	Regenerative Cracking
Acetone[3]	336,000,000	Butane	Isopropyl Alcohol	Tubular or Regenerative Cracking
Acrylic Resins	25,000,000[4]	Butane	Ethylene Propylene	Tubular or Regenerative Cracking
Ethyl Alcohol	344,000,000[4]	Ethane Propane	Ethylene	Tubular or Regenerative Cracking
Formaldehyde (40%)	485,000,000	Methane	———	Steam Conversion or Catalytic Oxidation
Methyl Alcohol	430,000,000[4]	Methane	Water Gas	Steam Conversion
Isopropyl Alcohol	380,000,000	Butane	Propylene	Tubular or Regenerative Cracking
Vinyl Resins[5]	100,000,000	Ethane Propane	Acetylene Ethylene	Regenerative Cracking

[1]Approximated by Chemical and Metallurgical Engineering (February 1943)
[2]From U. S. Tariff Commission (1942 Production)
[3]It is assumed that the greater portion of acetone is derived from isopropyl alcohol as shown.
[4]Estimated from basic data in Chemical and Metallurgical Engineering (February 1943)
[5]Includes Vinyldiene Chloride

Material Requirement: The total production of synthetic organic chemicals, by processes as shown, could be produced from the recoverable ethane, propane, butane fractions of 480 billion cu. ft. of natural gas (about 75% of the 1941 gas lost or wasted) with the accompanying methane and heavier residue converted into approximately 44.4 million barrels of gasoline, diesel, heavy oil mixture via the Steam Conversion and Fischer-Tropsch Processes.

TABLE 2. (Alternate Method).

Synthetic Organic Chemical	*United States 1943 Production (lbs.)*[1]	*Possible Processes and Raw Materials*		
		Basic Hydrocarbon Raw Material	*Intermediate Hydro-Carbon Raw Material*	*Processes*
Acetaldehyde	224,445,142	Ethane Propane	———	Oxidation
Acetic Acid (100%)	264,898,632	Ethane Propane	Acetaldehyde	Oxidation
Acetone	168,000,000	Ethane Propane	———	Oxidation
	168,000,000	Butane	Propylene	Tubular or Regenerative Cracking
Acrylic Resins	25,000,000	Butane	Ethylene Propylene	Tubular or Regenerative Cracking
Ethyl Alcohol	344,000,000	Butane	Ethylene	Tubular or Regenerative Cracking
Formaldehyde (40%)	485,000,000	Ethane Propane	———	Oxidation
Methyl Alcohol	268,500,000	Ethane Propane	———	Oxidation
	161,500,000	Methane	Water Gas	Steam Conversion
Vinyl Resins	100,000,000	Butane	Acetylene Ethylene	Tubular or Regenerative Cracking

[1]Refer to Table 1 for source of data.

Material Requirement: The total production of synthetic organic chemicals, by processes as shown, could be produced from the recoverable ethane, propane, butane fractions of 630 billion cubic feet of natural gas (total gas lost or wasted, 1941) with the accompanying semi dry gas converted into approximately 55.5 million barrels of gasoline, diesel, heavy oil mixture via the steam conversion and Fischer-Tropsch processes.

these fractions in the following study, with the lean gas then being converted into methanol and formaldehyde sufficient to fulfill the requirements of these products, and the remainder entering into the synthesis of liquid hydrocarbon fractions by means of the Fischer-Tropsch process. The conversion factors used are not improbable for the early post-war period.

In the recovery of the heavier hydrocarbon fractions from natural gas, their conversion into basic chemical raw materials, and their subsequent synthesis into organic liquids, the latest available recovery and yields were used. Inasmuch as part of the data is restricted, total requirements are given rather than any detail.

Reference to Table 1 divulges that the estimated production of these synthetic organic chemicals, as listed, could be derived largely through regenerative cracking from the recoverable ethane, propane and butane content of 480 billion cu. ft. of gas (about 75% of the gas reported lost and wasted in 1941). The residue dry gas could then be synthesized into 44.4 million bbl. of a gasoline, diesel oil, and heavy oil mixture. An alternate method, illustrative of the diversity and flexibility of available processes, is considered in Table 2. This method is constructed chiefly around oxidation processes presently being employed in the conversion of natural gas derivatives to certain basic chemical raw materials of use in the war effort. The synthetic organic chemicals indicated could be produced, again, from the reported 630 billion cu. ft. of gas loss and wastage in 1941, with the remaining semi-dry gas available for synthesis into approximately 55.5 million bbl. of a gasoline, diesel oil and heavy oil mixture.

Notably, also, the production of the majority of synthetic chemicals itemized in Tables 1 and 2 was achieved principally through use of ethane, propane and butane, or less than 20% by weight of the natural gas. Further, in view of the fact that ethane, propane and butane fractions are presently extracted from natural gas and are readily transportable by modern methods, this study loses its hypothetical character and assumes practical economic stature. It is, then, interesting to note that although dry natural gas (principally methane) is of importance as a chemical raw material, analysis of the extant situation suggests that the heavier available fractions be utilized. Such use will preserve for the natural gas industry its source material—dry natural gas.

Additional dry natural gas will also be made available for conversion into liquid hydrocarbon fractions, chiefly the aforementioned mixture of gasoline, diesel oil and heavy oil. Pilot plant operations are now getting under way, and it is altogether likely that in the near future natural gas will be a raw material in commercial scale operations. A potentially enormous volume of natural gas could thereby be utilized in supplanting the anticipated early decline in productivity of crude oil. However, it is the author's opinion that, although natural gas may be used in this capacity, its conversion to liquid hydrocarbons will take place in locations readily accessible to one or more fields but inaccessible to pipe line outlets, and where gas was perhaps even being wasted. Petroleum reserves should continue to bear by

far the greater part of the load through imports and new discoveries in the United States. When large-scale conversion is necessary, oil shale and coal may be expected to provide the principal raw material sources. Natural gas may play a part therein, but only on a secondary scale, since the huge quantities required for Fischer-Tropsch conversion may be prohibitive. Moreover, potentially greater yet less exhaustive needs exist for natural gas in its capacity as a chemical raw material.

The Future of Natural Gas as a Chemical Raw Material

An analysis of the future of natural gas in this capacity as a chemical raw material has its background in the role assumed in World War II. Today large quantities enter into the production of carbon black, absolutely essential in the successful use of synthetic rubber, not only for tire-compounding, as was the case with natural rubber, but for all other uses. Appreciable quantities of natural gas derivatives are also used in the production of synthetic rubber. Still other quantities enter into the production of modern aviation fuel. Some 50% of the emergency synthetic ammonia is produced from hydrogen derived through the decomposition of natural gas by the steam conversion process. Further, an as yet small portion of the synthetic organic chemicals listed in Tables 1 and 2 finds natural gas as the starting raw material. The present use of natural gas as a chemical raw material is in itself an amazing accomplishment, strongly indicative of post-war use.

It is evident from the foregoing considerations that the chemical product derivatives of natural gas provide the public with a potential source of new and improved materials—materials with amazing industrial applications, developed through the gas chemist's molecular magic. What may be less obvious is that they also present the gas industry, particularly, but not necessarily exclusively, with a potential source of new revenue.

By and large, the gas industry has played a passive role in the attainment of experience relating to the new Petro-Chem developments, as well as in the technical research which that experience precludes. It is to be hoped that the establishment of the Institute of Gas Technology at Chicago typifies a dress rehearsal for a more active role—one which Frank C. Smith, the President of the Southern Gas Association, has been most aggressive in demanding. The important work of the Gas Institute must be continued, even expanded, But this is only a start. Outposts should be established in colleges and universities throughout the country through grants set up by the gas industry.

From the foregoing it is evident that the natural gas industry has unlimited possibilities in the post-war period and many years thereafter. The reserves guarantee many years of successful operations with the heavier derivatives of natural gas becoming of increasing importance as chemical raw material in the ever expanding Petro-Chem operations. Although dry natural gas is of importance as a chemical raw material, less exhaustive needs exist for it, with present trends suggesting that the heavier fractions are more desirable for chemical processing. These conditions should preserve for the natural gas industry its source material — dry natural gas. Thus, a balanced market is being created to use the complete range of our gaseous hydrocarbons, assuring maximum hydrocarbon utilization with natural gas as a raw material.

War Interrupts Institute's Educational Program

THE Institute of Gas Technology at Illinois Institute of Technology will devote its activities exclusively to research for the duration, it has been announced by John I. Yellott, director.

The educational program of the Gas Institute has been suspended, for recent selective service orders have ruled that graduate students in engineering and science are no longer eligible for deferments.

Twenty graduate fellows were studying at the Gas Institute when classes ended in February with the closing of the winter term. They had been specially selected for this study through national search and competition.

In announcing the change, Mr. Yellott said: "This interruption of the educational program of the Gas Institute is an inevitable consequence of the changed emphasis of selective service. Although we regret that the educational program has had to be discontinued for the duration, we plan to re-establish it on an expanded basis when conditions permit. This halting of the student training program merely interrupts one phase of the service which the Gas Institute is rendering for the industry as a whole. The resources of the Institute will now be turned more vigorously to basic research.

Fundamental studies are about to be undertaken in both natural and manufactured gas. Methods of synthesizing liquid fuels from gas will be studied, from the point of view of adding a valuable by-product to the gas industry, and also of replacing oil for upgrading of gas. Basic studies will also be undertaken on the nature of the fluidizing process, which appears to offer so much towards the future development of the gas industry.

Facilities at the Gas Institute will continue to be improved and expanded. It is expected that new equipment for combustion laboratory and fluid metering laboratory work will be provided. Additions to the permanent Gas Institute staff will be made with a view to strengthening the teaching force.

Two of the 20 graduate fellows at the Gas Institute will join the full-time staff of the Institute, where they will work on war research projects. The other 18 will go into the armed services or into war industry.

Peoples Natural Gas Co. Rate Reduction Accepted

THE offer of Peoples Natural Gas Co. of Pittsburgh to reduce rates $221,232 a year and refund $500,000 to 160,000 customers in 14 western Pennsylvania counties has been accepted by the Public Utilities Commission, thus ending a controversy of seven years' duration.

In 1942 the commission ordered the company to reduce its rates a million dollars a year and refund two million dollars to customers for the years 1939 to 1941. The company appealed to the Superior Court, which returned the case to the commission for further action.

According to an announcement recently carried in Pittsburgh papers, the new rates, effective March 1 will affect 93% of all domestic and commercial customers of the company. The reductions will make the first 1000 cu. ft. of gas used cost $1.21, instead of the previous amount of $1.42. The rate for over 10,000 cu. ft. has been increased from 40c to 45c per Mcf. Thus until the customer's bill reaches $6.81 a month, his money will buy up to 350 cu. ft. more gas than formerly; but above the $6.81 level, his purchasing power declines until $8.70 buys the same amount (14,200 cu. ft.) as under the old rate.

Other revised rates were announced for domestic and commercial customers in Blair and Cambria Counties, and in Bolivar, Garfield, Laughlintown, New Florence, and Lingonier, Pa., in the local papers serving those areas.

DOMESTIC GAS RESEARCH

Gas Burner Design

Design Features of Aerated Flame Gas Burners

LEON OURUSOFF, member, Technical Advisory Subcommittee on Project No. 1, Domestic Gas Cooking Research, and W. R. TELLER, chief research engineer, AGA Testing Laboratories. Excerpts from a report, "Design and Performance Features of Post-War Gas Burners—Aerated Flames."

WHEN a primary air-gas mixture containing less than the theoretical air requirement is emitted through a burner port to a combination zone, the first reaction occurs on a surface of finite but small depth. This surface assumes the approximate shape of a cone and is generally referred to as the "inner cone" of the flame. This inner cone, which is shown in Fig. 1, is probably the zone in which hydroxylation occurs. The products of this initial combustion reaction are under favorable conditions carbon monoxide, hydrogen, complete combustion products (CO_2, H_2O and nitrogen) and possibly unburned combustible constituents. With additional air available adjacent to this inner surface, a secondary combustion reaction takes place which if all conditions are favorable permits any unburned products emitted from the inner cone to be completely consumed. Since this secondary reaction occurs as a result of diffusion of air into the stream of intermediate products emitted from the inner cone, combustion is progressive and requires a relatively long time interval and large volume. This zone of secondary combustion is usually termed "outer mantle" and is shown in Fig. 1 as the dark shaded area surrounding the inner cone. The haze surrounding the outer mantle is a zone of completely burned products of combustion, luminous by virtue of their high temperature. This is conventional Bunsen burner combustion.

Several inherently undesirable features of a Bunsen flame can be completely eliminated by the burning under appropriate conditions of primary air-gas mixtures containing at least all of the air required for complete combustion. The nature of combustion of such mixtures is radically different from that of mixtures containing less than the theoretical air requirement. With 100% primary air, complete combustion of an air-gas mixture leaving a burner occurs on the surface of the cone having a finite but extremely small depth. The appearance of such a flame as compared with that from a Bunsen burner is shown in Fig. 1. It will be noted that for an equal gas rate the conical surface defining the combustion zone is considerably shorter than the inner cone of a Bunsen flame resulting from combustion of an air-gas mixture containing 60% of the theoretical air requirement. The haze surrounding this inner cone defines a zone of high temperature incandescent products, luminosity of which is derived largely from radiation from CO_2 and H_2O. Note that the secondary combustion zone present with Bunsen burners has no counterpart in flames resulting from burning theoretical air-gas mixtures.

From the standpoint of domestic gas appliances, the principal advantage of theoretical combustion is that it can be completed regardless of the composition of the ambient atmosphere. In other words, the flame may be surrounded with a completely inert atmosphere or an atmosphere comprised of the products of combustion.

This characteristic of combustion of theoretical air-gas mixtures permits considerably wider latitude in the application of burners making use of this principle than prevails with Bunsen burners. A comparison of relative requirements for satisfactory application of Bunsen and 100% primary air burners based on consideration of the theoretical differences in combustion mechanics involved is illustrated in Fig. 2. With a typical application of a Bunsen burner as shown, provisions must be made for secondary aeration. Also, to provide optimum conditions for thermal efficiency and combustion, the area and location of the secondary air opening must be rather precisely determined. Burner ports are located with due regard to the requirement that each has access to secondary air and that flames and flue gases from each port do not serve as a blanket for any other. As will also be noted, ample space is provided so that the outer mantles of flames do not impinge on grate or utensil surfaces. Provisions for venting flue gases from the burner and combustion space are such that adequate area is provided for rather large quantities of excess air. No tendency exists for recirculation of flue gases such as might be with a more restricted combustion space.

In the 100% primary air burner illustrated in Fig. 2 no provision is

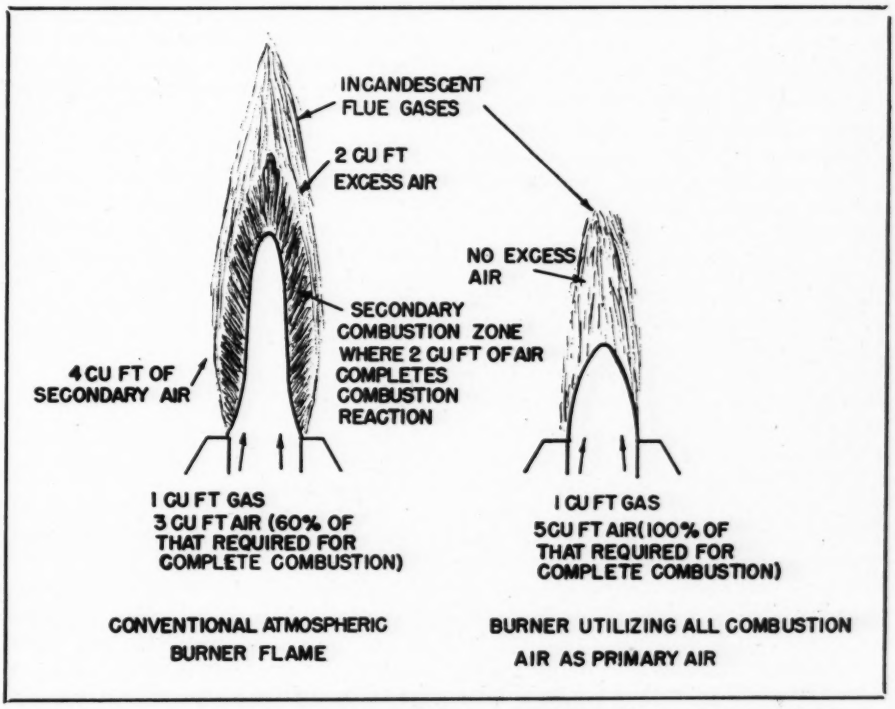

INCANDESCENT FLUE GASES
2 CU FT EXCESS AIR
NO EXCESS AIR
SECONDARY COMBUSTION ZONE WHERE 2 CU FT OF AIR COMPLETES COMBUSTION REACTION
4 CU FT OF SECONDARY AIR
1 CU FT GAS 3 CU FT AIR (60% OF THAT REQUIRED FOR COMPLETE COMBUSTION)
CONVENTIONAL ATMOSPHERIC BURNER FLAME
1 CU FT GAS 5 CU FT AIR (100% OF THAT REQUIRED FOR COMPLETE COMBUSTION)
BURNER UTILIZING ALL COMBUSTION AIR AS PRIMARY AIR

Fig. 1. Comparative characteristics of Bunsen and 100% primary air burner flames.

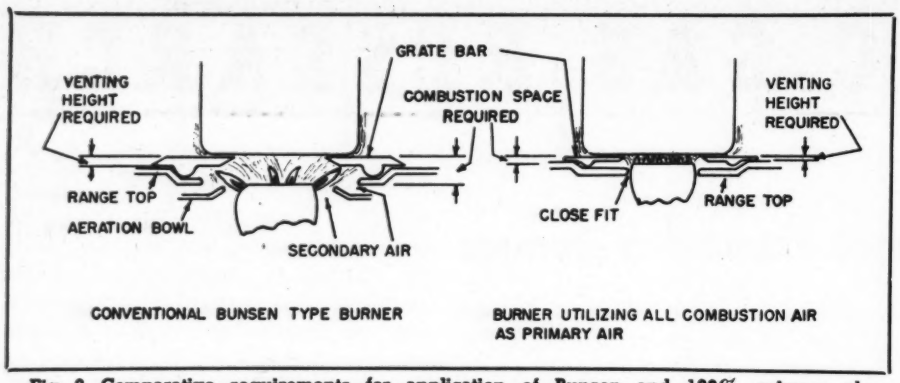


Fig. 2. Comparative requirements for application of Bunsen and 100% primary air burners in gas range top section.

made for secondary air as none is needed. Burner ports are located close together and combustion products from the inner flames pass directly over the outer ports. The burner nearly contacts the utensil bottom with only sufficient clearance allowed to prevent any interference with the short sharp flame cones. Venting height is considerably less than that necessary with Bunsen burners inasmuch as venting areas need not be designed for quantities of excess air and since possibilities of partial flue gas recirculation with such restricted venting can be ignored. The practical advantages are greater compactness, flush grates with better appearance, improved heat distribution, and possibly higher thermal efficiencies. More important, extremely high maximum input rates can be utilized with consequent drastic improvement in top burner heating speed.

In general, the preliminary investigation has indicated that utilization of all air required for combustion as primary air is productive of high thermal efficiencies and excellent heat distribution in gas appliances. The importance of these indications should be fully recognized especially with reference to modern gas ranges in which the near-ultimate in efficiency and heat distribution possible through conventional Bunsen burner applications has been reached.

It is appropriate to consider briefly inherent disadvantages of combustion of theoretical gas-air mixtures in domestic appliances which will require further research and ingenious development to overcome. These disadvantages are accentuated by utilization of fast-burning manufactured gases and do not, it is felt, present a major problem with natural gas. The first in order of magnitude is the tendency of theoretical mixtures of manufactured gases to flash back after a period of burning. This tendency can be overcome by two expedients; first, use of combustion rates per unit of port area of such magnitude that the exit mixture velocity is higher than the speed of flame propagation and secondly, use of porous ceramic material with extremely small uniform openings. The former expedient may require recourse to external motive force since potential energy available in low pressure gas does not seem adequate to overcome the high frictional resistance associated with the high gas rates per unit of port area necessary to prevent flash-back. However, possibilities of accomplishing the desired end with low-pressure gas still exist and are being actively studied. Recourse to porous ceramic material with sufficiently small openings also imposes a frictional resistance to flow beyond the ability of low-pressure gas to overcome. Use of such material would therefore also require an external source of energy.

The second major problem identified with combustion of theoretical air-gas mixtures is elimination of burner or combustion noise. It must be remembered that such mixtures are essentially an explosive combination of air and gas, the combustion of which is inherently a violent process. While considerable research has been conducted on this problem in the industrial gas field and solutions found, domestic gas utilization presents greater difficulties because of the lower noise levels desired. This problem does not appear to be insurmountable, however, as reasonable freedom from noise has already been observed under certain conditions of experimentation.

Other problems involve turndown characteristics and the effect partial closure of primary air openings by lint and dust would have on combustion particularly where no provisions are made for secondary aeration. Solution of such problems will also require additional research and contribute further to our industry's program.

Data on this type of gas burner are available in printed form in American Gas Association Testing Laboratories Research Bulletin No. 20, "Gas Burners Utilizing All Air for Combustion as Primary Air."

Gas Water Heater Research

Efficiency Aspects of Water Heating Research

W. R. FRASER, member, Technical Advisory Subcommittee on Project No. 2, Gas, Water Heating Research, and H. LUOMA, assistant chief research engineer, AGA Testing Laboratories. Excerpts from a report, "Fundamental Gas Water Heating Research Efficiency Aspects."

A CONSIDERABLE portion of the work conducted by the Laboratories under supervision of the American Gas Association Committee on Domestic Gas Research, has been devoted to research in the fundamentals of domestic gas water heating. The following bulletins relate to this particular phase:

Research Bulletin No. 9. Fundamentals of Domestic Gas Water Heating.

Research Bulletin No. 12. Principles of Gas Storage Water Heater. Design for Maximum Hot Water Delivery.

Research Bulletin No. 19. Effect of Cold Inlet Water on Performance of Automatic Storage Gas Water Heaters.

Bulletin No. 9 presents the results of studies of basic principles involved in the design of domestic gas water heaters. These include such items as heat losses from external surfaces and piping, standby losses, combustion chambers and flueways, and service efficiencies. Several of these subjects were studied in considerable detail and all provide information that is helpful to the designer and manufacturer of domestic gas water heaters.

Results presented in Bulletin No. 12 are confined to a single phase of water heater performance; namely, the obtainment of maximum delivery of usable quantities of hot water. The studies on which this publication is based consist essentially of an investigation of the influence of heat application to water heater storage vessels in producing stratification of hot and cold water during heating periods, and the effectiveness of dip tube design or other methods of introducing cold water to the storage vessel in accomplishing a separation of hot and cold water during draw periods.

Bulletin No. 19 is similarly limited to a single phase of water heater performance and deals primarily with the effect of cold inlet water on combustion, burner operation, flueway capacity, condensation, corrosion, and efficiency.

In general, studies referred to in the publications indicated were directed toward the accomplishment of two main objectives; namely, higher service efficiencies, accompanied by more reliable and consistent combustion characteristics; and such design features as would provide for maximum hot water withdrawal.

Additional research work recently inaugurated at the Laboratories includes further studies toward betterment of water heater service efficiencies especially by means of sizing, which by all indications appears to be a promising method for improving service efficiencies. Further, various types of automatic safety pilots used in water heater construction are being investigated at the present time.

This paper presents fundamental efficiency aspects of domestic gas water heating research as compiled from published bulletins of the American Gas Association's Testing Laboratories. Factors such as type and density of insulation, heat losses from external piping, and heat traps are evaluated in terms of standby loss and service efficiency. Effects of pilot rate, air circulation through heaters during standby periods, main burner input rate, and temperature of stored water on standby loss of automatic gas storage water heaters are discussed. Combustion chamber and flueway design for lower standby loss and higher thermal efficiency is briefly mentioned. A method for correct sizing of automatic storage gas water heaters to fit given service requirements is presented in detail.

Gas Cooking Research

Practical Phases of Research on Top Sections

F. E. VANDAVEER, assistant director, AGA Testing Laboratories. Excerpts from a report, "Practical Phases of Fundamental Gas Cooking Research—Top Sections."

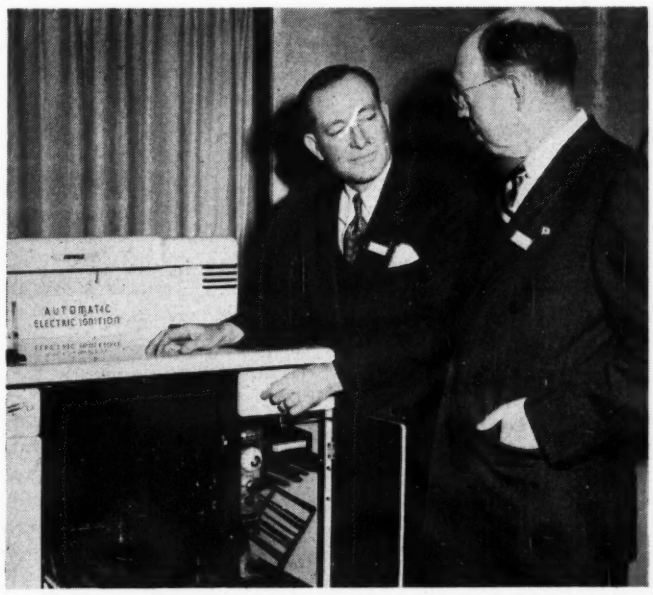
FROM the standpoint of both the gas industry and its customers, the gas range is the most important single appliance in use today. For years it has played an intimate part in the everyday life of a constantly growing number of gas consumers. Accordingly, when the present program of fundamental research was initiated by the American Gas Association in 1935, through its Committee on Domestic Gas Research, it was a logical development that the gas range receive first consideration. Since that time much intensive scientific study has been devoted to ways and means by which gas ranges could be further improved by proper application of basic scientific facts developed by this series of investigations.

Results have been made available from time to time through published bulletins, the first, No. 7, Domestic Gas Range Research, having been issued in 1936. Three others have since been produced—namely, Bulletin No. 8, Domestic Gas Range Research, No. 14, Fundamentals of Automatic Flash Tube Lighter Design, and No. 17, Automatic Flash Tube and Pilot Ignition of Oven and Broiler Burners on Manufactured Gas. Two more will shortly be available, one on Grate Design and Heat Distribution Characteristics of Top Burners, the other on Flash Tube Ignition of Ovens and Broilers on Natural and Manufactured Gas. Other current projects now in various stages of completion which will give additional fundamental data on gas range design include the following:

1. Gas burners utilizing all air for combustion as primary air
2. Control of primary air to gas burners by other means as well as by air shutter
3. Effect of chimney draft on oven and broiler performance
4. Ignition of gas with electricity
5. Use of radiant flames for improved gas broilers, and
6. Fundamentals of mixing tube design.

In addition to projects already completed or in progress, a number of others have been thoroughly outlined and can be undertaken when committee approval is granted and funds are made available. It will thus be readily apparent that the domestic gas research program on gas cooking is comprehensive and thorough. When carried to completion our industry should be equipped with basic scientific data so essential in the development of new and improved postwar appliances.

In this paper the major items applying to gas range top sections, presented in published domestic gas research bulletins and others soon to be released, are enumerated and discussed in order.



AGA Laboratories Director R. M. CONNER demonstrates the automatic electric ignition of the range oven for Southern California Gas Co. President F. S. WADE.

Automatic flash tube of the range oven catches the attention of Southern California Gas Co. Vice Presidents F. M. BANKS and H. L. MASSER.

Gas Burner Design

Design Features of Non-aerated Flame Burners

W. R. TELLER, chief research engineer, and K. H. FLINT, assistant chief research engineer, AGA Testing Laboratories. Excerpts from a report, "Design and Performance Features of Post-War Gas Burners—Non-Aerated Flames."

COMBUSTION of gaseous fuels without primary air presents several well recognized advantages including absence of noise, elimination of air shutters, no propensity to flash back, less susceptibility to changes in gas composition, and simplicity of design, construction and installation in an appliance. On the other hand, a major disadvantage of yellow flame burners in comparison with aerated flame burners such as the Bunsen type is the greater combustion space required for equal gas inputs. This factor has probably been more responsible than any other for the comparatively slow development in the field of luminous flame combustion as applied to domestic gas appliances.

Under certain conditions of port design and port rate, non-aerated flames* burn without yellow tips or luminosity greater than that provided by aerated flames. In the past, attention has been given, in so far as non-aerated flames are concerned, to the luminous or yellow flame types. In recent years, particularly in England, increasing consideration has been given to so-called non-luminous non-aerated flames resulting from combustion of raw gas without primary air. During research work conducted under supervision of the Committee on Domestic Gas Research of the American Gas Association at its Testing Laboratories, studies have included, in addition to the two general types of non-aerated flames just mentioned, combustion characteristics of non-aerated flames in tubes. This type of combustion may be likened to diffusion flames in that secondary air is admitted to the combustion zone progressively as combustion proceeds. Each of these three different methods of non-aerated flame combustion is discussed together with presentation of research data obtained to date.

There are two specific conditions for certain types of gas under which flames will burn with a clear blue flame without primary air. In one case this involves combustion at an extremely low rate per port. All city gases have the same behavior in this respect. Rates at which combustion of non-aerated flames is not accompanied by liberation of luminous carbon particles are generally so low that it is doubtful if this type of combustion would have practical utilization. It is conceivable, however, that some use might be made of it under carefully controlled conditions of burner design and application.

The second specific condition under which non-aerated flames burn without luminosity occurs at extremely high rates per sq. in. of port area. Before this limit is reached, a transition zone is passed. In this transition zone flames become extremely turbulent with luminosity present in some regions and absent in others.

Research on the tubular type of burner has recently been inaugurated. To date studies have been made on a burner consisting of a 98 in. length of 3/8 in. pipe having an exhaust blower at the outlet end. Indications are that stable flames will be obtained with this diameter tube at input ratings up to 15,000 Btu. per hour although it is possible to burn 20,000 Btu. per hour providing sufficient excess air is used. Percentage of excess air necessary for complete combustion increases as the input rate is increased with a given tube diameter. For input rates of 10,000 Btu. per hour, satisfactory combustion has been attained with excess air as low as 15%, while the air-free percentage of carbon monoxide was only 0.049 with 10% excess air. When excess air is increased above 75%, an unstable flame is produced and the percentage of carbon monoxide in the combustion products increases. Applying a safety factor, it might be stated that at 10,000 Btu. per hour input a 3/8 in. burner tube would operate satisfactorily within the limits of 20 to 70% excess air.

*Non-aerated flames are defined as those resulting from combustion of gas without primary air supplied to and mixed with the gas before the combustion zone.

Gas Heating Appliance Research

Noise and Heat Transfer in Heating Appliances

W. R. TELLER, chief research engineer, AGA Testing Laboratories. Excerpts from a report, "Noise and Heat Transfer Factors in the Design of Gas Heating Appliances."

LITERATURE on heat transfer is considerable. However, fundamental equations on heat transfer by conduction, radiation, and convection require a knowledge or assumption of values for certain variables before solution of design problems can be made. Hence, in designing heating elements of gas space heating appliances, use of fundamental equations would require an estimation of flame temperature or flue gas temperature and assumption of other variables comprising these equations. As a consequence, design values may be far from realized in the performance of the appliance when built, since errors in such estimates may well be cumulative.

Empirical equations for various specific conditions encountered in gas heating appliances to facilitate their design for maximum heat transfer and capacity characteristics must be found.

An important collateral aspect of heat transfer in gas appliances is the capacity of the heat exchanger to accommodate volume of flue gases required. In much of the classical heat transfer work, conditions established were inconsistent with problems involved in design of such equipment. As is generally recognized, a conventional gas appliance must incorporate in its own construction means for discharging the flue gases without aid from an external source. In other words, the theoretical stack draft created by the appliance must exceed, at least slightly, the frictional resistance of the flue gases produced for the designed input rate and excess air concentration.

Obviously, if an appliance operating at its designed rate and the minimum excess air concentration necessary for good combustion do not yield a satisfactory thermal efficiency, additional baffling which would increase heat transfer to the desired extent cannot be resorted to since combustion would be impaired. In other words, with atmospheric type burners and with only a stack draft embodied in the appliance, complete correlation must be made between heat transfer and capacity characteristics. This fact makes it even more advisable that empirical relationships based on adequate capacity and maximum heat transfer be developed.

In this paper, the theory of heat transfer by conduction, radiation, and convection are briefly discussed. Data on empirical overall heat transmission coefficients are given. Practical aspects for increasing heat transfer and thermal efficiencies are presented.

Theory of resonant noise generation is presented, and means of prevention or elimination are given.

Notes on Los Angeles Domestic Gas Research Conference

THE West Coast Conference on Domestic Gas Research held at the Ambassador Hotel on March 15 and 16 proved another long forward stride in gas industry progress. Some 200 Pacific Coast manufacturers and utility leaders vitally interested in improvement in gas appliances heard AGA Laboratories Director R. M. Conner, Chief Engineer K. R. Knapp, and Chief Research Engineer W. R. Teller lead discussions on the fundamental research that has been carried on by the Laboratories on behalf of the gas appliance manufacturing fraternity.

Since complete copies of the studies are available through the Laboratories and since abstracts of the papers appear in G A S (March pp. 13-21) and in the current issue beginning on Page 23, there is little need for added discussion here.

That the manufacturers are moving toward redesign and betterment of gas appliances was seen in the fact that many of them called for a second meeting on Domestic Research in the near future after they had had time to digest the foot-thick volume of basic research data which was dramatically presented to the delegates by Eugene D. Milener, secretary of the AGA Committee on Domestic Gas Research.

Probably the most important single achievement of the current research program (if not since the introduction of the Bunsen burner in 1855) is the development of the 100% primary air burner. It must be stated, however, that development of this burner is now in its primary stages, and that only through continued effort on the part of the Laboratories, the utilities, and the manufacturers can it be refined and adapted to the many purposes it can serve in appliance design.

Much discussion was evoked both at the general meetings and at the panel sessions. In achieving this end credit must be given the chairmen at the general session: W. M. Jacobs, chairman, Post-War Appliance Committee, Pacific Coast Gas Association; Mr. Milener, and H. W. Geyer (of Southern Counties Gas Co.), member, Technical Advisory Subcommittee for Gas Water Heater Research. Discussion was carried into the panel meetings.

Attendance was good and participation active at the cooking, water heating, and space heating forums held on the second afternoon of the conference.

Cooking Appliances: The panel session on gas appliance research, conducted by Guy Corfield, research engineer, Southern California Gas Co., attracted about 35 delegates, mostly manufacturers, who expressed great interest in the development of the 100% primary air burner. It was generally felt that, pending the solution of the problems of production and the elimination of certain difficulties such as flashback due to the rate of flame propagation, this burner might revolutionize gas appliance design. Interest was shown also in the non-aerated flame, although it was considered that this burner was not as adaptable to the range as the 100% primary air burner. K. R. Knapp, chief engineer of the Laboratories, participated in the discussions, answering questions as to technical details.

Water Heaters: The panel session on water heater development under the guidance of H. W. Geyer, utilization engineer, Southern Counties Gas Co., resulted in a variety of questions. The introduction of cold water into water heaters by inlet tubes, on which experimental work had been done by the laboratory was brought up and some discussion as to the height of the tube above the bottom of the tank and the type of opening at the end resulted. Among the other problems under discussion were (1) heat transfer through radiant type burners; (2) insulation, with the suggestion that some sort of machine be used to shake the insulation down before shipment so that it would not settle after installation; (3) excess air in water heater vents; (4) the size of pilot and the ranges of thermostat temperature in relation to standby loss.

On the question of the optimum size of water heater most efficient for various types of service, it was admitted that no factual data were available, although it was concluded that there is still a field in the small home for the small water heater. It was felt that the development of a simple water softener which could be injected into the water without trouble would be of great benefit in tank preservation.

It was generally conceded that the present water heater design was satisfactory, but that the coming pressure of competition would necessitate the combined efforts of the laboratories,

AGA LABORATORIES PACIFIC COAST EXHIBIT

THE research discussions were brought to life by an exhibit which was set up by the Laboratories in conjunction with the general meetings. Inspection of the various developments was constant and the value of the exhibit is seen in the fact that the manufacturers have petitioned the laboratories to set up a permanent exhibit at the Pacific Coast Branch of the Laboratories. The exhibit included the following:

Ranges: Two methods were shown which provide for igniting the oven without the use of a continuously burning pilot light. One method involves the use of an electric element activated by a switch which ignites gas emitted from a pilot orifice. As soon as the oven burners are ignited the pilot light is automatically cut off. The other method, flash tube ignition, was discussed in some detail by R. M. Conner in G A S, March 1944, p. 13.

Space Heating: Much fundamental research in this field has been devoted to the elimination of furnace noise, with particular reference to resonant noise. It was found that a closed-end side tube attached to any part of the furnace piping system would cause interference sound waves eliminating the noise.

Burner Design: Exhibits were shown of three new types of burner—(1) a 100% primary air burner which allows the gas to burn in its own combustion products and permits close contact with the vessel to be heated (See page 23.) (2) A non-aerated tubular diffusion flame burner in which the gas is sucked through tubes by a vacuum, with combustion taking place throughout the tubular area. This burner permits of heating without contact with the flame and in the absence of combustion products. (3) A non-aerated non-luminous flame burner which produces an open gas flame with no primary air.

Burner Design: One of the exhibits was devoted to a shutter on a mixing tube which was designed to regulate the air so that it would pass through a circular opening rather than through a narrow slit. This improvement mitigates clogging of the mixing tube with lint, dust, etc.

Water Heaters: Three types of baffles which might be used in water heater manufacture were demonstrated. It was found that a circular baffle which directly obstructed the flow of flue gases was most efficient in transferring heat to the heater.

War Products: In conjunction with the domestic gas research exhibit the Laboratories presented samples of the oxygen regulator, pressure-reducing regulator, oxygen therapeutic set, and helium meter which have been developed by the Laboratories for use in aircraft.

the utilities, and the manufacturers in improving water heater efficiency.

Space Heaters: The elimination of resonant noise in furnaces was the primary topic of discussion in the furnace manufacturers panel session which was presided over by Ray Logue of Ward Heater and E. L. Payne of Payne Furnace and Supply Co. W. R. Teller, chief research engineer of the Laboratories carried the discussion with a discourse on the research done (See Page 26). His remarks were supplemented by Arthur Theobald of Payne Furnace, who related his experiences in solving this problem with particular installations. It was brought out that experience with one furnace would not necessarily solve the problem with another; that units would react differently at different altitudes, that generally speaking there was as yet no fool-proof answer to the problem, and that the problem is not common enough to warrant extensive research on the part of the Laboratories.

The trend in furnace design is toward much more compact units with higher Btu. input. In this connection reference was made to the aircraft heater developed by Surface Combustion and described in G A S, March, 1944, p. 27.

A social climax was added to the sessions when the visiting delegates from the Laboratories and 150 Pacific Coast Gas industry men attended the annual stag party given by the Institute of Gas Heating at the Mayfair Hotel on Thursday evening. Eric S. Slater, general manager, Ideal Heating Corp., was in charge of the event.

The Laboratories Personnel and Their Work

R. M. CONNER, director, AGA Testing Laboratories. Excerpts from an address, "Our Industry's Domestic Gas Research Program."

EVERYONE in the gas business probably understands the objectives of the present domestic gas research program. There are many, however, who are not entirely familiar with the detailed manner in which it is carried out or the personnel and facilities available for doing so. The activity centers in the AGA Committee on Domestic Gas Research, headed by Messrs. E. J. Boothby and F. M. Banks, with Eugene Milener as its Secretary, to outline broad phases of the program, and equally competent technical advisory groups to supply the necessary details.

Mr. Boothby's committee meets periodically to review progress, outline new objectives, and most important of all, consider ways and means of raising necessary funds. Meetings of the technical advisory groups are much more numerous and the volume of their work is heavy. For the most part, these groups are composed about equally of gas appliance manufacturers and utility engineers. All of them are experts in the type of equipment they are assigned to consider.

To date, our domestic gas research has been confined to the more common types of household equipment, such as ranges, water heaters, space heaters, and central heating appliances. Naturally, portions of these appliances, such as, for example, burners, thermostats, lighters, thermostatic pilots, etc., will be regarded by some as accessories, yet they have been included to round out the whole picture.

Laboratory has published 26 technical bulletins: As has often been stated, our investigational activities are directed along fundamental lines. Accordingly, they are designed to provide handbook data that can be utilized by anyone properly qualified to improve the construction and performance of contemporary types of domestic gas-burning equipment. This material is represented by the 26 Laboratories bulletins now available for our industry's use. Although not every one of these publications refers specifically to domestic gas equipment, they all involve some phase of utilizing city gas, and for this reason are recommended for study by manufacturers' engineers designing gas appliances and for utility engineers who must service and use them.

We can all derive a great deal of satisfaction from the fact that our industry's leaders had sufficient foresight at the proper time to provide the necessary funds for effectively adding to our store of technical knowledge. Their action was especially propitious for the reason that we hope to encourage many existing manufacturers to meet the post-war period with new and better appliances. Furthermore, many manufacturing plants now devoted to the production of war products will convert to the manufacture of appliances consuming gas, and as a result will require, or certainly should have, all the guidance we can possibly provide them. Our industry cannot accommodate equipment the performance record of which is so unsatisfactory that it may reflect discredit on the whole general structure of our business. In other words, poor appliances not only damage the reputation of the man who produces them, but everyone else engaged in the same line of business.

That we will be faced with tremendous post-war competition there can be no doubt. Our principal competitor will, in all probability, be as in the fairly recent past—electricity. Despite the fact that, contrary to public opinion, we distribute about six times the amount of energy in the form of city gas that the electric industry does in the form of electricity, and 11 times if we include gas utilized for the production of carbon black, the growth of the electric business is increasing by leaps and bounds. The only justification for this fact, if any, is the alleged tag of modernity associated with the use of electric equipment and service. It might seem that an appropriate counter move would be the employment of effective counter advertising, although this is only one part of the eventual solution. We must have efficient, safe, and above all, attractive equipment to supply prospective new gas users and to meet all replacement requirements.

Domestic research conferences are extremely encouraging signs. They prove that the gas business recognizes its problems, and what is a great deal more important, is determined to do something about them. Our objectives are common to all, and for this reason, if for no other, they will require our best cooperative efforts for their successful attainment. It seems to me that our various technical bulletins

BULLETINS ON DOMESTIC GAS RESEARCH

(Published by the AGA Testing Laboratories, Cleveland, Ohio)

Bulletin No.	*Cost*
7—Domestic Gas Range Research	$1.00
8—Domestic Gas Range Research—Second Bulletin	1.50
9—Fundamentals of Domestic Gas Water Heating	2.00
10—Research in Fundamentals of Atmospheric Gas Burner Design	2.00
12—Principles of Gas Storage Water Heater Design for Maximum Hot Water Delivery	1.25
13—Fundamentals of Design of Atmospheric Gas Burner Ports	1.75
14—Fundamentals of Automatic Flash Tube Lighter Design	1.25
16—Relation of Burner Volume to Ignition and Extinction Characteristics of Gas Range Top Burners	1.25
17—Automatic Flash Tube and Pilot Ignition of Oven and Broiler Burners on Manufactured Gas	1.25
18—Summer Air Conditioning	2.50
19—Effect of Cold Inlet Water on Performance of Automatic Storage Gas Water Heaters	1.25
20—Gas Burners Utilizing All Air for Combustion as Primary Air	1.25

represent a series of potential guide books that can be successfully utilized in accelerating our progress. It doesn't necessarily follow that everyone who employs them ends up at exactly the same place. On the other hand, to use a common figure of speech, we should it seems, be in a position to assume safely that anyone who does so won't be clear off the map. There has, very frankly, been too much rule of thumb in the past. The world just won't wait on an industry or even a business that proceeds on a basis of cut and try.

Laboratory personnel: It will be of interest to all, to explain the nature of the organization that has been responsible for the production of some six technical bulletins on domestic gas research as well as a large share of the technical papers presented at this conference since January first last. At the present time, we have 12 experienced engineers on our Cleveland research staff and 14 women, making in all a total of 26. Two of these men hold doctors' degrees, and several more are masters of science. The average length of service for the men is about 10 years. While the women have, for the most part, been employed since the war began, they are all college graduates. Several have had home service experience with gas companies, and most of them possess a thorough background of academic training in physics or chemistry or both. Our equipment, as some of you know, is the most modern available, and the basic training which all of our employees receive in our gas appliance testing and inspection departments fits them ideally from the standpoint of experience for productive research work.

Our research department is headed by W. R. Teller, chief research engineer, who also supervises our War Products Department. Mr. Teller is assisted by Messrs. Flint and Luoma, assistant chief research engineers. The latter is a former employee of the Pacific Coast Branch. K. R. Knapp, our chief engineer, in addition to his many other duties, assists in the editorial work of the research department. As might well be imagined, the volume of such work is substantial, and Mr. Knapp's 33 years service in the gas business affords a most valuable background of experience.

Thanks to the relatively large volume of war work initiated prior to the time the war began, it has been possible for our Laboratories to retain a competent and experienced staff, while at the same time the American Gas Association has been able to make a substantial and very direct contribution to the nation's war effort. For this our industry can largely thank the very able guidance afforded by our Laboratories Managing Committee headed by G. E. Whitwell and represented on the Pacific Coast by our Association's immediate Past-President, A. F. Bridge.

America now seems to be winning its war, and in my humble opinion the greatest single contributing factor to this accomplishment is its unparalleled industrial efficiency. This factor, combined with the unlimited courage of our fighting men, should keep our nation great. Gas must continue to play its part in this picture. As a matter of fact, it is now in countless ways providing the best that can be offered in the way of an industrial fuel. After the war there is no sound technical reason why it should not continue to do this and also carry a major portion of the American people's every day domestic load which, theoretically at least, seems so ideally suited to gas.

The Manufacturers Must Stand Together

A. H. SUTTON, general chairman, Manufacturers Section, Pacific Coast Gas Association. Excerpts from an address given before the Domestic Gas Research Conference in Los Angeles.

THE gas industry is a big business. The manufacture of gas appliances is a small business by comparison with other manufacturing lines. This is both a handicap and a help. While we do not enjoy all technical advantages that size alone can bring, our very numbers give us the economic seedbed from which should rise the majority of new ideas and new methods. As individual companies we lack the extensive research facilities enjoyed by some of the larger manufacturers of competitive appliances. This is a handicap but not one which cannot be overcome. If our manufacturers will meet this challenge with the same spirit of ingenuity and resourcefulness shown in the production of war goods, then I am confident we shall equal or excel the achievements of our competitors.

We have an industry problem and its solution depends upon our willingness to contribute to a common pool ideas and improvements for the betterment of our appliances, which wartime conditions have amply demonstrated we possess. To supplement our individual efforts in the field of research, we have at our command laboratories of the American Gas Association which rank second to none in their field. These facilities plus our own efforts give us little reason to fear competitive manufacturing groups because of size alone. If our products do not keep pace, it will be because we have failed to exploit fully our advantages.

The Competition to Come: Postwar conditions may well see competition keener than ever before. Not alone among ourselves but among industries as a whole, competing for the consumer dollar. We should not, therefore, permit our own competitive conditions to blind us to the necessity of close cooperation in matters of industry welfare. Although we may dislike losing business to a competitor, we must realize that greater loss will inevitably result, if through the lack of industry cooperation we lose our market to a competitive fuel.

Wartime measures and conditions have taught us some of the benefits of cooperation. If in the postwar period we can work together as well in contributing to the common cause the wealth of new ideas we are capable of in the field of research and design, our industry can face the future with confidence.

The subject of appliance improvement is of vital concern to utility companies and one for which we can count on their help and support. However, we should neither ask nor expect them to do a job which is the responsibility of the manufacturer. It is up to us to accept the leadership and initiate a broad, long term program of product refinement, both for our own interest and that of the entire gas industry.

Aggressive Advertising Essential: Such product improvements as we may make must in turn be supported by aggressive advertising, designed to acquaint the public anew with the merits of gas appliances.

As a result of wartime demands, the nation's plant capacity, much of it readily convertible to the production of consumer durable goods, has undergone a tremendous expansion. This fact alone makes more evident than ever the need for sustained advertising on the part of the gas industry. Utility companies and manufacturers alike will have to expand their advertising budgets. To meet these new conditions we need to reappraise our position.

The responsibility for promotional advertising, I think, properly belongs

with utility companies. Such expenditures must be supported by manufacturers with strong campaigns of product advertising of sufficient magnitude to equal in scope the efforts of manufacturers of competitive appliances. This can only be accomplished through a cooperative plan, supported by all manufacturers, large and small, working through their various association product divisions. I see no other solution to the problem, for there are few, if any, of our manufacturers large enough to engage in product advertising on a scale necessary to maintain leadership in the home appliance field.

It is my frank opinion that gas appliance manufacturers, as a whole, are entirely too complacent in their views as to the possible inroads that may be made in our markets by appliances using competitive fuel. While I know it is the consensus that the buying public will have more money to spend in the immediate postwar period than ever before in peacetime, it would be a fallacy to assume, even if this be true, that we can maintain our sales volume by offering substantially the same products sold in prewar years.

Fundamental Research and Appliance Development

F. M. BANKS, vice-chairman, AGA Committee on Domestic Gas Research. Excerpts from an address, "The Relationship of Fundamental Research to Gas Appliance Development."

WHAT is the proper function of American Gas Association research? Is it to provide a "socialized" service so that anyone can take the material thus provided and become a manufacturer? Is it simply a matter of letting American Gas Association spend research dollars so that manufacturers will not have to spend them? If that should be the result, it is my opinion we would be doing a grave disservice to the industry in the long run. This industry, with few large manufacturers, needs alert, able concerns whose interests are "gas" who will undertake their full responsibility in producing increasingly improved appliances. We need to support such manufacturers.

We cannot, however, overlook the fact that the utilities have an enduring investment in this business. It has no other means of selling its services than through appliances which are offered. They cannot see them fail to keep up with competitive needs.

I should like to restate the four principles set down by Frank Adams at the Technical Conference held in February in Cleveland.

1. Gas service must be promoted in terms of gas appliances.
2. Utilities have the major stake in the development of competitive appliances.
3. Utilities need a sound, loyal manufacturing industry.
4. Appliance research and development can best be done by the manufacturers.

"In the light of these principles, it seems to me the question of applied versus fundamental research begins to lose importance. The real question is, 'What are the most constructive and the best policies for the gas companies to follow to increase research, to make it most effective not only in just producing an improved appliance today but to continuously meet the competition of other equipment and the challenge of other industries?'

"The gas industry should not take the direct responsibility for research. The utilities should do everything they can to encourage and augment research, to supplement it where necessary. This does not mean they should not appropriate money for research. They should—but use it to stimulate the research expenditures of others, not as a substitute for it. The objective of the Domestic Research Committee or of AGA should not be to gather all research unto itself, like the development of a one-man organization, but to develop and encourage the contributions of others."

Mr. Adams then went further in proposing that the greatest amount of research would be best produced for the industry as a whole if association funds were to be expended to assist manufacturers directly in carrying out certain investigations. While it is not entirely clear to me just what procedure would be most fruitful, I agree with Mr. Adams only in very special cases. It is my conviction that the work we have been doing is in the right direction, because we have such a large amount of catching up to do. We probably have some years of work before us to fill the great gaps in our technology of gas utilization. For example, we had to go back 50 years to find the last work which had been done on certain phases of the technology of combustion.

Some hold the opinion that when we finish with an investigation, the job is done, and that anyone can put the information to work simply by reading bulletins. This is far from the fact. Instead, these data become useful only by employing the brains and ingenuity of trained technical personnel to apply them in the appliance field itself. The actual application of this basic technology to the appliances themselves leaves the widest range for ingenuity, craftmanship and manufacturing skill.

It is common knowledge that many manufacturers have learned entirely new manufacturing technique and precision methods. It is our purpose to provide them with much new basic knowledge in the field of gas technology. It is our hope that the same manufacturers will rely in greater degree than ever before upon their technicians to aid in applying that knowledge. Their technicians need the broadening contacts which can result from conferences of this sort. They should be encouraged to collaborate with the Technical Advisory Committee of the various research projects to the end that the greatest good will result.

W. H. VOGAN, supervisor, Pacific Coast Branch, AGA Testing Laboratories; EUGENE D. MILENER, secretary, AGA Committee on Domestic Gas Research; and K. R. KNAPP, chief engineer, AGA Testing Laboratories, pose before the exhibit at the Los Angeles conference.

Arkansas-Louisiana Gas Co. Rebuilds Ford Street Station

The Shreveport Arkansas-Louisiana Gas Co. Distribution Department has completed the dismantling of the old Ford Street regulator and gas measurement station and has replaced it with new, up-to-date equipment.

This station is the connecting link between the Gas Pipe-line Department and the Gas Distribution Department; it also feeds the city belt line and is so constructed that both the city line and the industrial line can be supplied at the same time. It is equipped with automatically controlled 8-in. regulators which feed into a 16-in. header supplying two 10-in. lines to Shreveport's largest industrial consumer.

CORROSION AND PROTECTION

Of Buried Metallic Structures

Compiled and Abstracted by GUY CORFIELD, Technical Editor, GAS

2. Corrosion Coupons

Corrosion Coupons and Pipe Life Prediction

W. R. SCHNEIDER, Bureau of Tests and Inspection, Pacific Gas & Electric Co. Excerpts from a paper, "Corrosion Coupons and Pipe Life Predictions," presented before the Fifth Soil Corrosion Conference, National Bureau of Standards, St. Louis, Mo., March, 1943.

CORROSION coupons or corrosion test plates are removable steel plates buried near a pipe line or other structure on which it is desired to know the rate of corrosion which takes place over a period of one or more years, due to soil action, stray railway currents, long line currents, etc.

The coupons, or plates, are installed in pairs at pipe depths in the following locations:

1. Wherever the general electrolysis survey indicates that the steel pipe is discharging an electric current into the soil at a rate of one or more milliamps per sq. ft. of exposed pipe surface.
2. Where appreciable pitting has been found on examination of the pipe surface.
3. Where pipe failures have occurred.
4. At the limits of, and in cathodically protected areas to show the effectiveness of the protection.

The data obtained by the annual study of a series of coupons covering a period of years are used to estimate the probable life of the pipe and the economic feasibility of applying one of the different types of pipe protection now available.

When corrosion plates are installed on pipe covered by a protective coating or wrapping, it is necessary to consider the degree of protection given by the pipe covering. This can be determined by measuring the current flow in the pipe on each side of the corrosive area or coupon location to show if a current is lost from the pipe to the soil through the wrapping. This latter test can frequently be made by the use of an earth current meter, of the McCollum type, to measure the current passing through the low resistance portions of the pipe covering to the soil. The contactor in this case is placed directly against the covering of pipe.

Coupons connected to a pipe covered with a coating having high insulating properties (at the suspected location) could still show signs of corrosion but would not show the true condition on the pipe surface.

An obvious example of a case of this kind is that portion of a pipe which crosses a marsh on a trestle. A coupon buried in the corrosive soil of the marsh and connected to the pipe on the trestle would show a considerable loss of weight and pitting due to the galvanic potential existing between the marsh soil and the higher soil on either bank. The corroded condition of the coupon would not be indicative of the corrosion on the pipe at that location which is obviously not affected by the corrosive marsh mud below. The insulated pipe would merely act as a conductor between that portion of the pipe in mildly corrosive soil on the distant bank and the corrosion coupon in the highly corrosive mud of the marsh.

Description and Installation of Coupons: The corrosion coupons are 3x6x5/16-in. steel plates cut from 5/16x3-in. hot rolled steel bars. These coupons shown in Fig. 1 are cleaned by sand blasting, then drilled, numbered and weighed.

Coupons obtained in this manner have been found to give better results than those obtained from plates cut from the steel pipe. The cost of the former is considerably lower. The increased facility of measuring pit depth on a flat plate increased the accuracy of these measurements.

Practically no difference has been found between the pitting and weight loss of the coupons made from the 5/16x3-in. flat steel strap and those cut from the 20-in. steel main.

The plates are used in pairs and buried near the bottom of the pipe as shown in Fig. 2.

Soil taken from the bottom of the excavation is freed of all rocks and

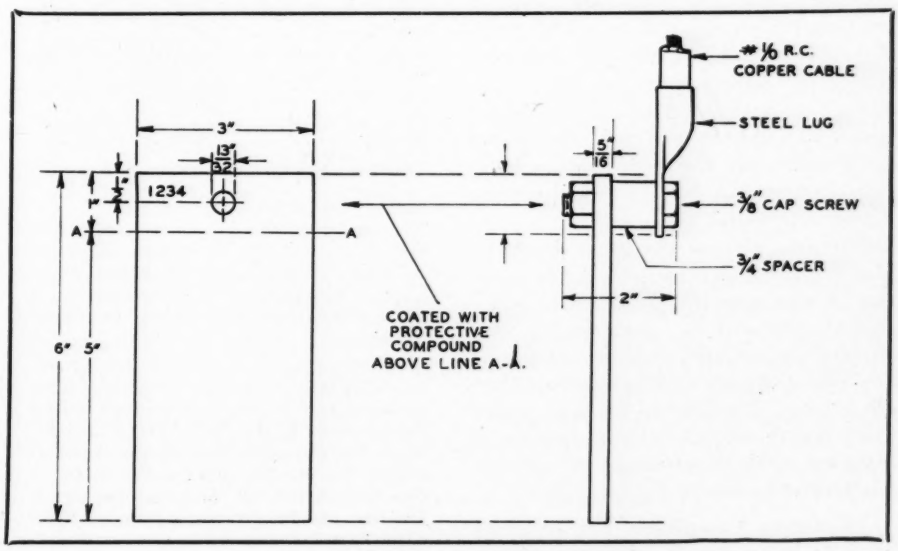


Fig. 1. Corrosion coupon dimensions.

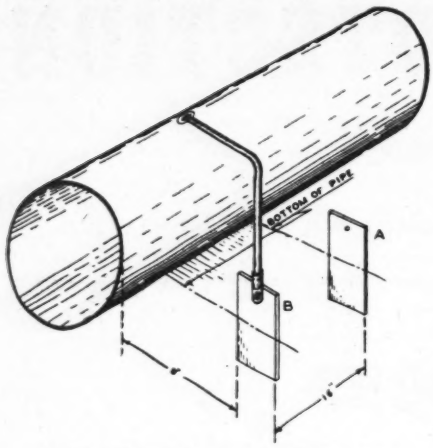


Fig. 2. Corrosion coupon location.

pebbles and tightly packed around the plates before the opening is backfilled.

The "control coupon," "A," is not electrically connected to the pipe. This coupon is attacked by the corrosive action of the soil only, and the pitting and weight loss varies from year to year with the annual changes of rainfall, irrigation or changes in drainage.

The "pipe coupon," "B," is electrically connected to the pipe by soldering or brazing as shown in Fig 2, with a No. 1/0 rubber covered cable.

This coupon is acted on by the stray currents and long line currents as well as by the corrosive action of the soil.

All exposed copper brazed connections, and those portions of the steel plate with the lugs and bolts above the line "A - A" of Fig. 1 are heavily covered with asphalt or some inhibitive pipe coating material to prevent local corrosion.

The corrosion coupons, except in a few special cases, are allowed to remain in the soil for a period of 12 months, and then replaced with a new pair of plates. The 12-month periods are usually terminated in the fall of the year and the plates are changed before the winter rains set in. Later in the year many portions of the country in which the most corrosive areas are located, are flooded, making coupon changing in many cases difficult if not impossible.

The time of removal is of considerable importance, since an additional wet or dry season will make it difficult to compare the corrosion of the current period with that of the previous year. This is due to the fact that all wet and dry seasons are not of the same length, nor are the annual rainfall, moisture penetration or average temperature always the same.

Cleaning Coupons: The coupons are usually covered with considerable rust and scale after being in the soil for a 12-month period. These corrosion products must be removed and all pits cleaned before the pit depths can be determined.

The cleaning is carried out with a minimum of labor by making the rust covered steel plates the cathodes between graphite anodes in a 2% solution of sulfuric acid.[1] A direct current of approximately one ampere or more per coupon is passed through the electrolyte, the coupons being allowed to remain in the bath all day or overnight. Since the metal coupons are electrolytically protected in the acid electrolyte while the current is flowing, no corrosion of the steel coupons will take place after the adhering oxides are reduced. It is unnecessary to turn off the current or remove the plates from the solution at any definite time.

The plates when removed from the cleaning tank are bright and clean with only an occasional very deep pit requiring additional hand work.

After the plates are removed from the acid solution they are washed in fresh water, dried and rubbed with an oiled cloth to avoid tarnishing.

Measurement of Pit Depth: The pit depths on the coupons are measured by clamping the plate horizontally in a holder which is moved on a surface plate under a micrometer gauge. Both sides of the coupon are explored with the gauge and the deepest pit located. No measurements are made at the edges, where the corners are usually rounded off or destroyed by the simultaneous action of the soil on the two intersecting metal surfaces.

[1]This method was described by McCollum and Logan of the Bureau of Standards' Bulletin No. 25, "Electrolytic Corrosion of Iron in Soils," June 12, 1931, p. 7.

Calculations From Pit Depth: The effective area of a coupon exposed to the action of the soil is only 33¼ sq. in. The deepest pit found on this area is multiplied by two, to approximate the deepest pit that is likely to occur on the surface of a pipe having over 100 sq. ft. exposed to the soil[2].

The pit depth/time equation used to correct the measured pit depth for time of exposure and to calculate the pipe life is the parabolic equation suggested by Putnam.

$$P = Kt^n$$

in which

P = Depth of pit at end of t years.
K = Initial pit at end of one year.
t = Number of years during which pipe or coupon was exposed to the corrosive action of the soil.
n = Exponent which varies between 0 and 1 and is, to an appreciable extent a function of the aeration of the soil; it approaches the lower limit in well-aerated soil and unity in poorly aerated soils such as moist clay, moist adobe, swamps, etc.

Since an average pipe line in open country is poorly aerated in winter during the rainy and flood seasons, and may be comparatively well aerated during the summer months, an average value of n=.5 is used.

Putnam,[3] experimenting with the 80 soil samples of the bureau of standards, found the value of n=.61, but later considerations showed that the value of .5 was sufficiently accurate for all practical purposes.

This exponent will vary with the soil formation encountered in different localities, but agrees well with actual cases of the pipe life predictions and pipe failures.

The equation used for determining the pit depth at any time is therefore,

$$P = Kt^{.5} \qquad \text{Equation (1)}$$

The equation used in reducing the corrosion coupon pit depths to a one-year basis if the actual exposure has been greater or less than 12 months is,

$$P = \frac{p}{t^{.5}} \qquad \text{Equation (2)}$$

in which

P = Max. corrosion coupon pit depth per year.
p = Max. pit depth found on coupon exposed more or less than one year.
t = Time of exposure of corrosion coupon.

[2]"Soil Corrosion Testing," by K. H. Logan, S. P. Ewing, and I. A. Dennison, Symposium of Corrosion Testing Proceedings, pp. 100 and 108, American Society for Testing Materials, Philadelphia, Pa.

[3]"Soil Corrosion," by J. F. Putnam, Standard Oil Co. of Calif. Proceedings, 16th Annual Meeting, American Petroleum Institute, Los Angeles, Calif., November, 1935, Vol. 16(IV), p. 66.

GAS presents the fourth in a series of articles on the protection of buried metallic structures. The series covers the following general subjects: (1) Electrical Potential Phenomena (GAS, Jan., Feb., and March); (2) Corrosion Coupons; (3) Pipe Coatings; (4) Cathodic Protection, Theory and Research; (5) Cathodic Protection, Influence on Adjacent Structures; (6) Cathodic Protection, Application; (7) Miscellaneous—Soil Surveys, Special Problems, Anaerobic Corrosion.

Guy Corfield

In compiling and editing the series, Mr. CORFIELD, has used as source material more than 40 papers presented before the meetings of the Fifth Bureau of Standards Soil Corrosion Conference, the American Gas Association, the Pacific Coast Gas Association, the American Petroleum Institute, and the Petroleum Industry Electrical Association.

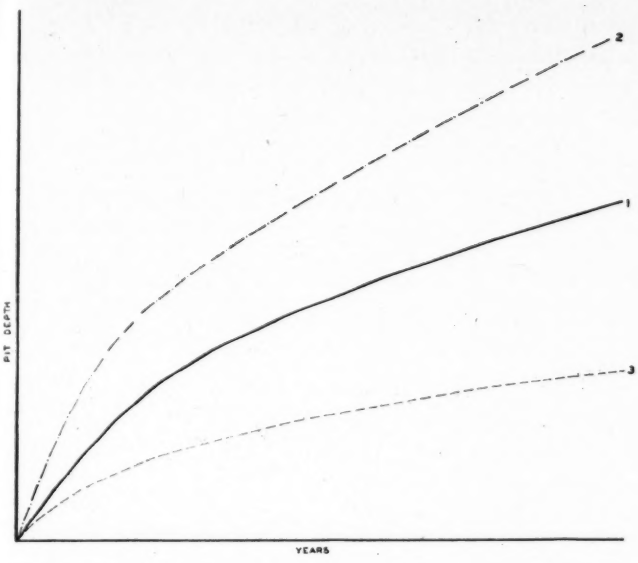


FIG. 3. Time-pit depth curves for three different soil corrosivities.

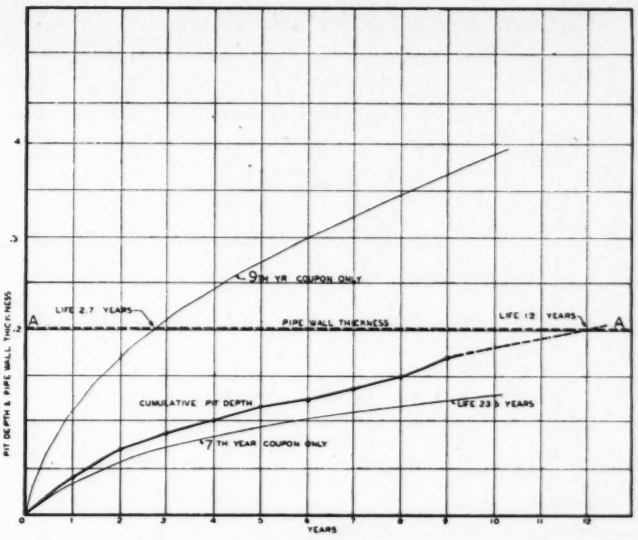


FIG. 4. Cumulative pit-depth-lifetime curves. Pipe: O.D., 6 in.; wall thickness, .203 in. Installed 1925. See Table 2.

The pit produced on a corrosion coupon which is placed in the ground for a period of 12 months is a measure of the average corrosion taking place during the year on a newly installed line, and the pit depth on the coupon will be equivalent to the depth of a pit produced on a pipe during the first year after its installation.

If the average annual corrosivity is constant over a period of years, the pit depth will increase at a decreasing rate as shown by curve No. 1 of Fig. 3.

The intersection of these curves with the line "A - A," showing the pipe wall thickness, will give the expected or theoretical pipe life. (See Fig. 4.)

As a first approximation the pipe life may be calculated from the pit depth indications given by the first one-year corrosion coupon by the equation

$$L = \left(\frac{T}{2P}\right)^2 \qquad \text{Equation (3)}$$

in which

L = estimated theoretical pipe life in years.

T = pipe wall thickness in inches.

P = maximum corrosion coupon pit depth.

2 = constant used to correct for area.

The corrosivity of the soil is seldom constant during a long span of years as was assumed in plotting the curves of Fig. 3 except in the case of marshes, tidelands and similar locations.

The pitting of the control coupons shows that the corrosivity of the soil may vary over a wide range during a period of years.

In determining the actual progress of corrosion in pitting a pipe, and in order to determine the life of a pipe of known wall thickness, it is necessary to make due allowance for this annual variation of the soil corrosivity, the age of the pipe and that of the pits existing thereon.

The "increase" in the depth of a pit during any year in terms of the pit depth produced by the soil during the first year of its action on a pipe as shown by the pipe coupon (the soil corrosivity being constant from year to year) is given by the equation

$$A = \sqrt{n} - \sqrt{n-1} \qquad \text{Equation (4)}$$

A = Activity factor—increase of pit depth each year in terms of the pit depth produced on a newly installed pipe during the *first* year.

n = Years of exposure of the pipe, to the soil action, from the time of its removal to the date of the installation of the corrosion coupon under study.

TABLE 1

Age of Pit	*Pit Depth*	*Activity Factor Per Year* $A = \sqrt{n} - \sqrt{n-1}$
1	1.000	1.000
2	1.414	.414
3	1.732	.318
4	2.000	.268
5	2.236	.236
6	2.449	.213
7	2.646	.197
8	2.828	.182
9	3.000	.172
10	3.162	.162
11	3.316	.156
12	3.464	.148
13	3.605	.141
14	3.742	.137
15	3.873	.131
16	4.000	.127
17	4.123	.123
18	4.243	.120
19	4.359	.116
20	4.472	.113
30	5.48	.101
40	6.32	.084
50	7.07	.075
75	8.66	.016
100	10.00	.013

The "activity factor," "A," for any year is given in column 3 of Table 1, or can be found by the use of a table of square roots.

The amount that is added to an existing pit during any year is found by multiplying the area-corrected maximum pit depth of the corrosion coupon of that year by the "activity factor" corresponding to the age of the pit, which is usually the age of the pipe since its installation.

The use of this factor of activity is illustrated by the following examples:

The maximum pit found on a 12-month pipe coupon is .075 in., and the probability is that the deepest pit that can be found on a one-year-old pipe will be 2x.075 in. = .150 in. A pit on this pipe developing for eight years before the above coupon was installed will increase in depth during the ninth year only a fraction of the .150 in. Referring to Table 1, the factor for the ninth year is given as .172.

Therefore, the increase pit depth will be:

$$.172 \times .150 = .026 \text{ in.}$$

If the total depth of the deepest pit on the pipe at the end of the eighth year was .224 in., the pit depth at the end of the ninth year will be:

$$.224 \text{ in.} + .026 \text{ in.} = .250 \text{ in.}$$

Interpretation of Data: The following example will illustrate the method of accumulating the annual contributions to the depth of a pit in a soil of varying corrosivity.

The results of the coupon tests given in Table 2 are shown graphically in Fig. 4.

The pit depth curves, based on the highest and lowest rates of pitting during the seventh and ninth years, as indicated by the coupons of those years

TABLE 2

Corrosion coupon installed when pipe is laid. Pipe wall thickness = .203 in.

(1) Age at Pipe Years	(2) Max. Pit Depth on Pipe Coupon	(3) Max. Pit on Corrosion Coupon Corrected for Area (X2)	(4) Activity A Per Year in Terms at First Year	(5) Pi/Yr. = Increase in Pit Depth on Pipe	(6) Total Accumulated Pit Depth	(7) Pit Depth Based on 7th Year Low Rate Only	(8) Pit Depth Based on 0th Year Low Rate Only
1	.024	.048	1.000	.048	.048	.042	.124
2	.031	.062	.414	.026	.074	.060	.175
3	.031	.062	.318	.020	.094	.073	.214
4	.038	.076	.268	.010	.104	.084	.248
5	.036	.072	.236	.017	.121	.094	.277
6	.022	.044	.213	.009	.130	.103	.304
7	.021	.042	.197	.008	.138	.111	.328
8	.032	.064	.182	.012	.150	.119	.350
9	.062	.124	.172	.021	.171	.126	.372
10	.040	.080	.162	.013	.184	.133	.392

only are also shown for comparison.

The intersections of these curves with the horizontal line "A - A," indictates that pipe wall thickness shows the estimated pipe life, and also shows the wide range and contradictory pipe life estimates that may be obtained as a result of relying on the indications of coupons of a single year only.

If corrosion coupons are installed on an old line, a number of years after the line was installed, a similar procedure can be used, accumulating the missing data as an average corrosion rate based on an equal succeeding period.

When corrosion coupon data for a number of years are not available, and the work will not permit the necessary delay of several years to obtain these coupons, a portion of the line may be excavated and examined.

The deepest pit found on 100 sq. ft. of the pipe surface examined, may be used as the starting point, by being placed in column 6 of Table 2 opposite the year corresponding to the age of the pipe. The calculations of the pit depth are then continued by accumulating the amount obtained from the corrosion coupons as in the foregoing example.

Coupons that are removed once a year have undergone a complete cycle of seasonal weather and annual soil corrosivity changes.

They are the "guards" or "watchmen" placed on a pipe line to record the progress of the corrosion, and give notice of accelerated corrosion which may cause leak failures sooner than was previously anticipated.

If the coupon indications are ignored by failure to make the changes and studies at one-year intervals, the failure of the pipe may be the first indication that a serious change has taken place. The annual change of the coupons will avoid many "surprise attacks" on the line, due to pipe line extensions, electric railway changes, irrigation and other changes, and the saving in repair costs will be greater than the cost of many annual changes of the test plates.

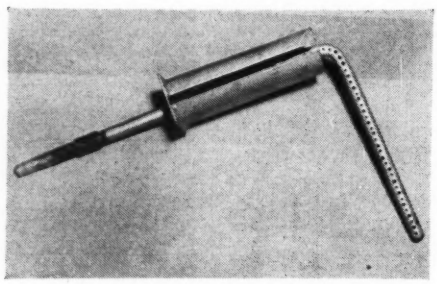
Pit depth measurements on a coupon buried for a period of two to five years may become practically worthless for the purpose of determining the conditions that exist at a given location, as the pit may be caused by:

1. The accumulated effect of a mildly corrosive soil over a long period of time, which would indicate no great danger to the pipe line.

2. A temporary severe condition that existed at some time in the past and has since abated, thus requiring no mitigative measures at the present time.

3. Severe corrosive conditions that have developed just before the plate was removed, and required immediate investigation and the application of mitigative measures.

These three conditions could produce the same size of a pit, but it would not be possible to differentiate between them on one single long-term coupon.



Heater Pilot Light

Developed by FRANK ROTHWELL, Southwest Louisiana industrial engineer, United Gas Pipe Line Co., Shreveport, La.

THIS pilot light with a wind shield was developed for and is especially adaptable to use on flowing gas heaters which raise the temperature of gas in the lines to prevent freeze-ups and stoppages. Burners are thermostatically controlled. They shut off when required gas temperature is reached and come on again when temperature drops to the danger point.

Expanding gas produces a drop in temperature. Consequently, heating equipment is needed at points of regulation in fields, on tap lines and at city gate stations where excessively high pressures are cut to lower pressures.

A dependable pilot light often provides the difference between a frozen line and the continuation of uninterrupted service.

Emco Makes Own Tin Plate

The installation of a continuous, automatic electroplating department by the Tin Meter Division of the Pittsburgh Equitable Meter Co. has recently been announced.

The manufacturer states that this equipment has been installed to make possible continued manufacture of EMCO Tin Meters from heavy gauge meter plate. It is further declared that the quality of the electroplated tin coating is much superior to that formerly secured from outside commercial sources.

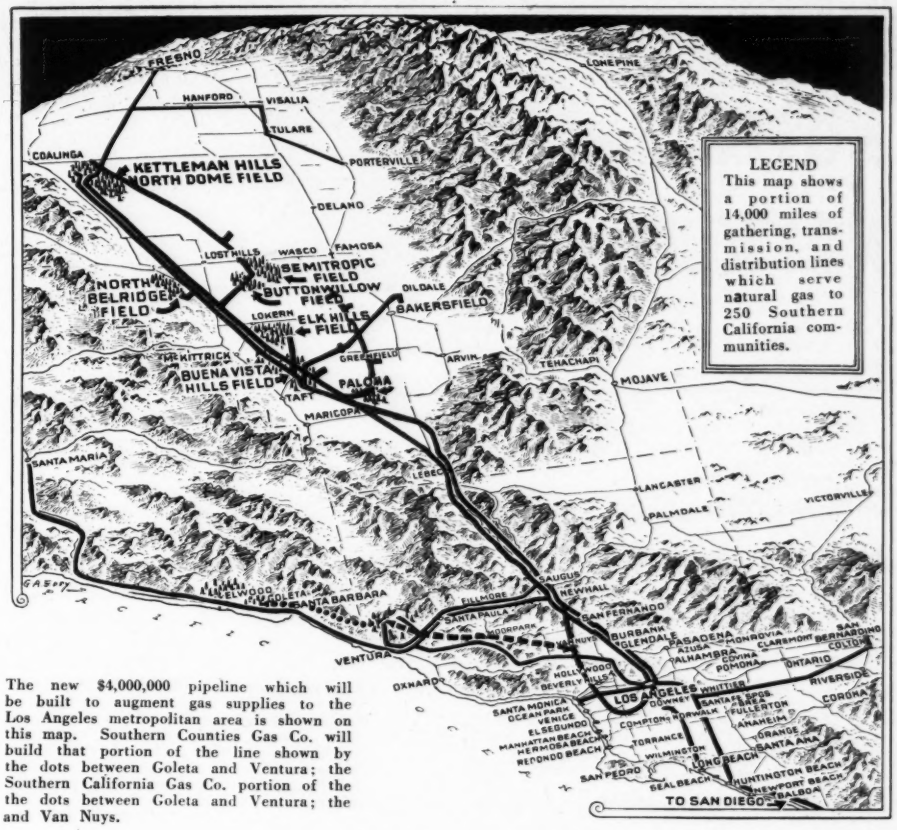
Other advantages claimed are (1) the component parts are stamped and deep drawn before they are plated, thus eliminating rust-inviting surface cracks; (2) the edges of the parts are coated and sealed to eliminate another common point for corrosion attack; (3) the quality of the plate is automatically controlled to produce a smooth even coating without high or low spots, pin holes or surface flaws.

WPB Approves Goleta-Los Angeles Pipe Line

THE War Production Board early in March approved the construction of a 104-mile high pressure pipeline from the La Goleta dry gas field above Santa Barbara to the Los Angeles metropolitan area. The $4,000,000 project which will include construction of gas wells, compression and dehydration facilities, will be jointly undertaken by Southern California Gas Co., Southern Counties Gas Co., and Pacific Lighting Corp.

The new pipeline, according to preliminary plans will provide a net increase of 164,000,000 cu. ft. for peak day use by essential customers. Company engineers state that the project is the most economical possible in labor and materials, and offers the only means of providing the needed capacity by the winter of 1944-45.

Need for added facilities urgent: Construction of the line is made necessary by the increasing trend of the firm load and the declining trend of oil well gas production in California. Southern California gas executives estimate that unless action is taken now these trends will create a serious situation within two years which will become more acute as time goes on.



The new $4,000,000 pipeline which will be built to augment gas supplies to the Los Angeles metropolitan area is shown on this map. Southern Counties Gas Co. will build that portion of the line shown by the dots between Goleta and Ventura; the Southern California Gas Co. portion of the the dots between Goleta and Ventura; the and Van Nuys.

War demands for petroleum products have tilted the California oil production curve to its highest point in the state's history, an increase from 600,000 to 800,000 bbls. per day. Despite this 33% increase in oil production, available gas per barrel of oil has declined about 35%. In addition petroleum engineers forecast a decline in wartime production of oil beginning in 1945. Furthermore, it is assumed that the end of the Pacific war would bring a return to approximately the pre-war rate of oil production, and this would mean further curtailment in available gas.

The proposed project will provide the needed additional capacity for the next two winters, provided gas is stored at Goleta during the summer months.

Construction and Operation: The project consists essentially of a 16 in. transmission line from La Goleta to Ventura, an 18 in. transmission line from Ventura to Haskell Station on the outskirts of Los Angeles, and a 22 in. line from Haskell Station to the Hollywood holder station. In addition to these pipelines it will be necessary to drill possibly four additional gas wells at Goleta and install compressor and dehydration equipment at that point. It will also be necessary to convert part of an existing compressor station at Ventura from 400 psi, discharge to 1000 psi discharge, install dehydration equipment there, and provide certain reinforcements in the transmission system in the Los Angeles area.

The proposed pipeline will roughly parallel the lines through which gas now flows from the La Goleta and Ventura fields to Los Angeles.

While the project does not provide a new primary source of gas, it does increase existing capacity both to transport gas from Goleta to Los Angeles and to store gas in the La Goleta field. During peak load periods, La Goleta gas will flow through pressure regulating equipment and a dehydration plant into the proposed line at 1000 psi. and thence to Los Angeles without recompression. At Ventura gas from the existing La Goleta to Ventura pipeline will be compressed from 225 psi. to 783 psi., dehydrated and discharged into the proposed line. During the summer, oil well gas produced in the Ventura field will be compressed to 1000 psi. and transported to La Goleta through the new pipeline, where it will be compressed to 1900 psi. and injected into the dry gas field to replace gas removed during the previous winter.

The project is designed to use a minimum of critical materials and equipment. By operating the Goleta to Ventura Section at 1000 psi. most of the compression required for the injection of gas at Goleta can be done at Ventura where there is surplus compressor capacity in the summer.

CONSTRUCTION DETAILS

Pacific Lighting Corporation

Four dry gas wells
Three 650 hp. compressor units with building and piping
Field lines and collection system, regulators, meters, etc.
Dehydration plant
Alterations to Pacific Lighting Ventura Compressor Plant

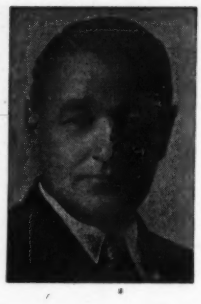
Southern Counties Gas Co.

La Goleta to Ventura pipe line 16 in. O.D.—1000 lb. working pressure, 36.3 miles long, including line valve, initial and terminal orifice meters, etc.
Install 1600 ft. of 12¾ in. O.D. ¼ in. wall pipe on McFarlane Avenue, Ventura
Convert 14 compressor units to 1000 psi, discharge pressure
Dehydration plant

Southern California Gas Co.

Ventura to Los Angeles pipe line, including valves and fittings—55 miles of 18 in. O.D. and 12 miles of 22 in. O.D.
Three pressure control stations
Alterations to Compressor Plant at Ventura
Reinforcements of transmission system in Los Angeles area to permit handling of deliveries from the new transmission line. Eight miles of 16 in. O.D. and 2 miles of 12¾ in. O.D.

Post-war NOTES and NOTIONS



By STANLEY JENKS

Self-analysis

IT has been suggested by one of our younger brethren that a lot of today's post-war verbiage is merely yesterday's garbage with perfume added, and that instead of painting glamorous pictures of a gas-fueled future, it would be far better and healthier for the industry if our oldsters would be men enough to list their pre-war mistakes, and make this list available to their understudies and successors by way of emphasizing that these errors should not be perpetuated or even repeated.

As one of the oldsters, I have been very much perturbed about this, since what is really being suggested is that we oldsters start asking ourselves questions, and if we are mentally honest, we start answering them frankly and truthfully.

One of the first obvious questions is that of our pre-war sales policy. Was it satisfactory? More important still, were we ourselves satisfied? Did our sales policy produce a maximum of increased load for the effort and money expended? Was it, for example, in complete harmony with the best long-range interests of our company? Were our salesmen trained and paid merely to sell gas appliances, or were added load and the merits of gas service *through* gas appliances primarily emphasized? Did our sales policy restrict gas sales by building a fence around our territory, over which willing cooperating dealers and manufacturers could not climb at a profit?

Anyway, there's a good start in this self-analytical quiz program, on which we are both quiz master and board of experts. The answers should be illuminating.

Survival

The AGA Post-war Planning Committee, under the chairmanship of A. M. Beebee, Rochester Gas & Electric Corp., is really at work and doing a good job. Its second report, issued early in March and representing the first report of the sub-committee on "Competitive factors affecting the realization of potential markets," is something that every gas utility executive ought to have on his reading *must* list. It outlines the clearest pattern to date for a local approach to an economically sound post-war domestic sales policy. R. J. ("Bud") Rutherford, Worcester Gas Light Co., chairman of the sub-committee, has good reason to be proud of the contributions to the report made by R. E. Ginna, Rochester Gas & Electric Corp., N. B. Bertolette, Hartford Gas Co., and B. A. Seiple, Jersey Central Light & Power Co.

There is a strong temptation to discuss the report here, but perhaps at this stage, it is better to let the report speak for itself. Thousands of copies have been issued throughout the industry, and like the seed in the parable, their value will depend on how many fell by the wayside, on stony ground, among thorns, or on good ground where the seed "bare fruit an hundredfold." May the crop of stimulated post-war planning justify the committee's efforts.

There is one point in R. E. Ginna's report, however, that needs underlining now in manufactured gas circles. He states *domestic manufactured gas service, even including a considerable increase in space heating, is barely holding its own.* This is in comparison with a natural gas growth of 14% in the 1934-42 period, and electricity domestic increase of 60%. Along these lines, I wonder if G. A. Neal, Sioux City, is still of the same mind as he was five years ago, when in a Guest Editorial for GAS, discussing the survival of the manufactured gas industry, which he diagnosed was basically a question of rates, he wrote:

> "I believe that the big item is the rate situation.
>
> "An analysis of all kinds of public service shows that the average domestic customer can spend $3.00 per month, but above this amount, he must have a bargain if he is to concentrate his fuel purchase in any one service. Some method of pricing must be found which will bring the retail price of gas to an extreme bargain above this amount. My own opinion is that the retail price should not exceed three times the production cost per thousand for any use over 2000 cu. ft. per month, and above 10,000 cu. ft. per month, the retail price should not exceed two times the production cost. This last rule should also be applied to all commercial and industrial rate schedules. At first thought, it may seem that there will not be sufficient margin to pay a return on the investment, but with a goodly volume of business, wouldn't this be enough?"

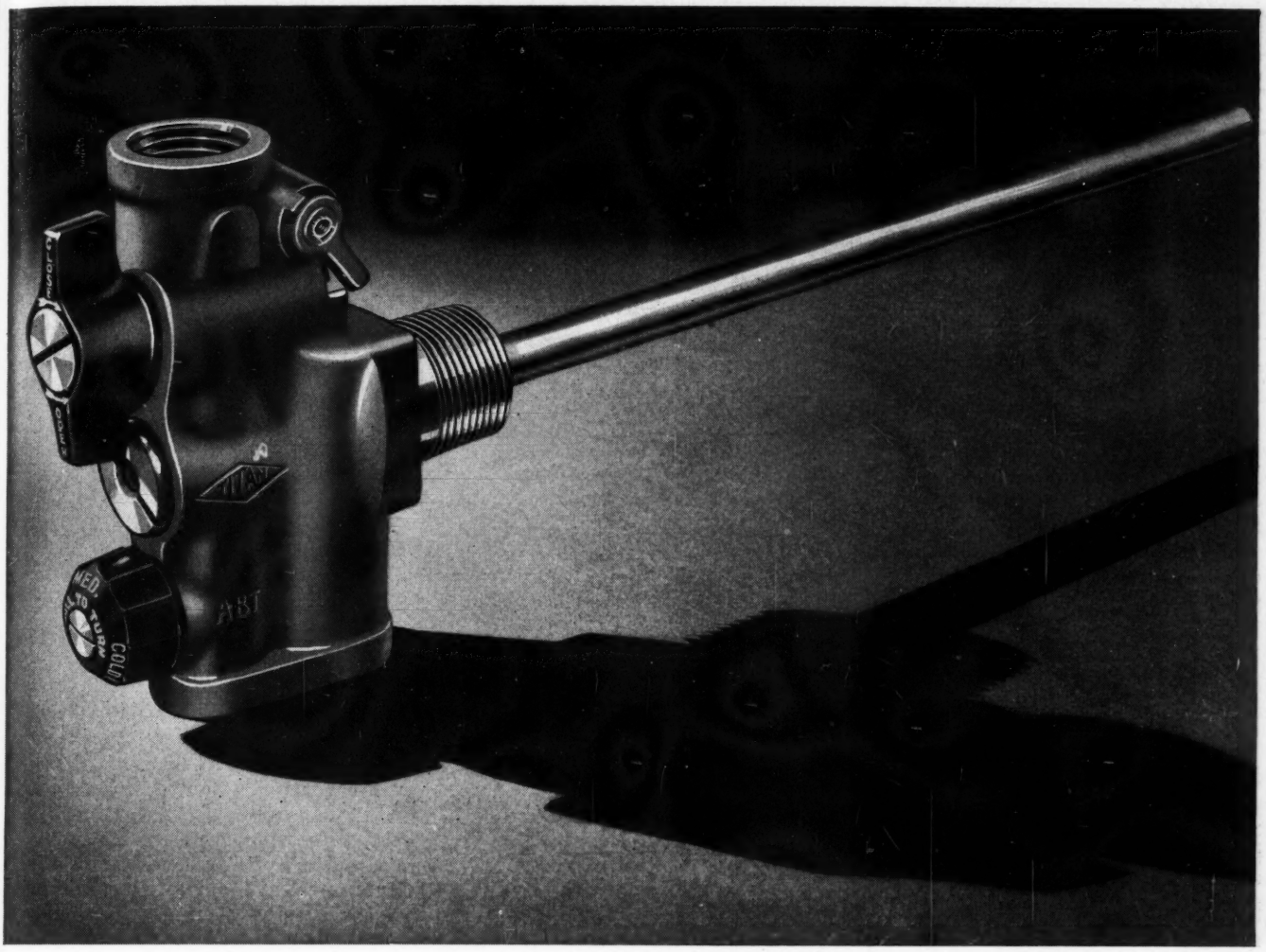
Messrs. Ginna and Neal are both experienced "combination" executives.

Tactics

After reading not once, but several times, every available paper and report emanating from the recent AGA conference at St. Louis, I have to conclude that our post-war strategy has been fairly completely defined. The four basic studies of the AGA Post-War Planning Committee, headed by A. M. Beebee, Rochester, will about say all that can be properly said at this time. For example, C. V. Sorensen, Hammond, Ind., took care of the post-war market by estimating there will be a backlog of 8 to 9 million gas ranges, 5 million automatic gas water heaters, and 2 million gas refrigerators, "just to catch up."

R. J. Rutherford, Worcester, Mass., has analyzed the various factors involved in realizing the goal set up by the Sorensen sub-committee. As a member of the Rutherford sub-committee, R. E. Ginna, Rochester, N. Y., has done an excellent job of reviewing the gas industry's relationship with the electric industry, which he rightly concludes will be our chief fuel competitor. Hall Henry, as chairman of the sub-committee on Engineering and Economic Phases of the Gas Industry, has outlined a program to investigate costs very thoroughly and to find out what can be done, if anything, to lower them or at least to use them advantageously in post-war promotional work.

The board of strategy is on the job, and already has outlined enough so far to make tentative tactical plans possible on a local basis. And there, my friends, is the nub of all this work by the Post-War Planning Committee. National strategy isn't worth a sprig of Schickelgruber's moustache unless it is implemented with a local tactical plan to make it work. In other words, the AGA proposes, and the member gas company disposes.



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Oklahomans Discuss Post-War Problems

By O. D. HALL

Gas Staff Representative

PAPERS and discussions on post-war planning held the center of the stage at the annual convention of the Oklahoma Utilities Association in Oklahoma City, Okla., March 14. Most speakers agreed, however, that plans should not be based on dreams or wishful thinking but upon conditions which the industry knows will exist after the war.

Two speakers in the Gas Division meeting particularly emphasized this viewpoint. Carl H. Dean, heating engineer, Oklahoma Natural Gas Co., Tulsa, in a paper entitled "There Ought to be a Law," declared that most post-war planning is predicated on that "Wonderful word IF." "Why not deal with facts as they are and developments that are certain, and make preparations to take action now to meet known post-war problems."

The speaker placed the utilization of natural gas in the home in a foreground position of importance to Oklahoma. "House heating cannot be considered as a package proposition," he continued. "The heating problems vary over the United States as the climate varies, and obviously the equipment best suited for New England is not the answer for California.

"There ought to be a law covering the fundamentals of application and installation of gas-fired domestic heating equipment in the State of Oklahoma, no matter where in the state the installation takes place," Mr. Dean declared. "This law should require that every domestic gas-fired appliance offered for sale in Oklahoma should bear the seal of approval of the American Gas Association Laboratories. Other requirements should include the placing of proper guards on the appliance and attachment of a tag designating it as 'Auxiliary Heating Equipment' and including printed instructions that the appliance was not designed to carry the major portion of the heating load but that this should be borne by fully vented equipment. Repetition of the venting practices of the past 10 years must not be permitted. Oklahoma can take the lead and show the industry how to correct this nation-wide abuse," Mr. Dean concluded.

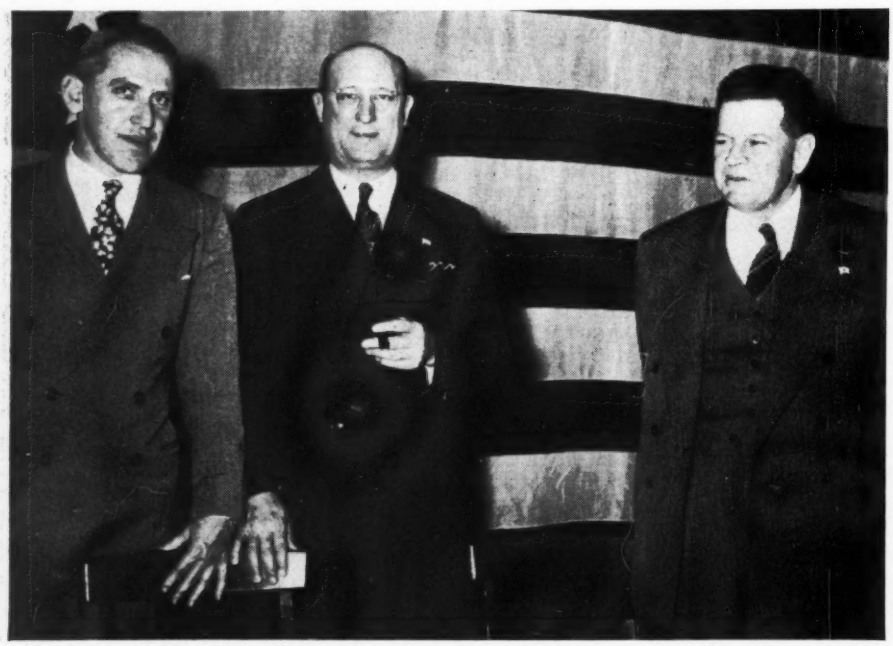
It is not too early to begin planning to maintain the post-war gas load, asserted C. Y. Young, research engineer, The Gas Service Co., Kansas City, Mo. Declaring that the, "battle for the cooking load has only just started," the speaker continued, "The cost of fuel will, in the long run, have very little to do with the type of fuel which eventually will be used to cook American meals. It probably will be safer at the outset for us to admit to ourselves that practically all our cooking customers can afford electric cooking if they want it. I therefore believe that the only way which the gas industry can save the cooking load is to make it easier for the average housewife to cook her meals better with gas than she can cook with electricity or some other fuel."

Mr. Young believes that the gas industry should not depend upon manufacturers or others to solve their fundamental problems but should assist in every way in the improvement of appliances.

Possibilities of all-weather air conditioning in building up the post-war gas load were outlined by John A. Gilbreath, assistant manager, air conditioning division, Servel Inc., Evansville, Ind. He said that this development was ready for mass production when Pearl Harbor came. He said that 3 to 5-ton units are all ready to go, when the war ends and that a demonstration home will be built in Evansville, as soon as material can be obtained. Meetings are being held to further tests of all-year refrigeration heating and air conditioning units. He expressed the belief that gas companies can double their domestic sales of gas after the war if they familiarize themselves with this development and make intelligent and aggressive plans to take advantage of its sales possibilities.

A. A. Brown, Oklahoma City, vice-president, Oklahoma Gas and Electric Co., speaking in the Electric Division meeting, declared that a great post-war market for appliances awaits the utility industry, if a political economy exists which encourages risks of capital in manufacturing and sales ventures, and utility and appliance manufacturing management is ready to take aggressive steps to capture this market. These markets lie in the great demand for materials and equipment to replace goods destroyed or used up because of the war; in the heavier earning power of the average citizen; in the fact that the consumer was unable to meet all his needs during the depression and during the war period; and also in the vast demand for products of new inventions or developments of science, such as television, radar, electronics and plas-

The public utility industry should



Oklahoma Utilities Association leaders D. S. KENNEDY, treasurer; A. F. POTTER, second vice president; and E. C. JOULLIAN, president.

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Gas Ranges bearing the famous CP Seal meet the highest performance standards of engineers and home economists of the entire Gas industry. That is why the CP Seal is the American woman's buying guide—the symbol by which all cooking appliances are judged—the nationally advertised emblem your customers will look for on your sales floor.

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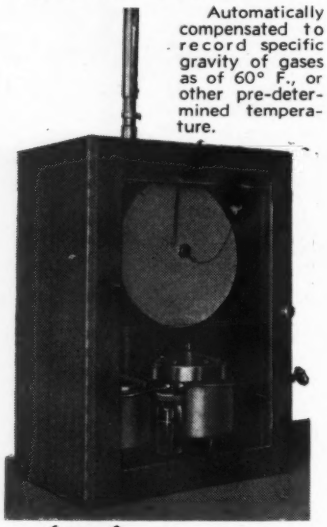

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make plans now to absorb its share of the services of the unemployed after the war, and shorten, so far as possible, the period in which government may be tempted to re-engage in the business of employment relief, J. A. Whitlow, vice-president, Public Service Co. of Oklahoma, Tulsa, told the Electric Division of the Association.

The energy equivalent of about 24,000,000 men should be given the opportunity, after the war, to produce their food on their own land-tracts and thus become independent and self sufficient, said Elmer T. Peterson, editorial writer for the *Daily Oklahoman*, Oklahoma City, in a paper before the general session. He advocated the rebuilding of the soil in America through, "construction of billions and trillions of little dams, some so small you can see them only through a microscope." These, he declared, would be more effective in flood control than all the big so-called flood control dams that have been constructed. Reservoirs created by the latter, he asserted, are rapidly filling up with silt washes from the good top soil and they will fill up within 15 to 50 years so they will be rendered absolutely useless either as flood control or electric power projects.

Wide divergencies between principles of the New Deal and fundamental principles upon which the United States Government was founded, were charged by J. C. Happenny, president, Oklahoma Power and Water Co., Sand Springs, Okla. He said that the whole 175 years of our history have demonstrated the strength of the principles of individual ownership and enterprise.

A statewide survey of industrial possibilities of all of Oklahoma is now being made by the Oklahoma City Chamber of Commerce, which intends to go out after new industries and expansion of those already within the state. This was revealed by Oscar Monrad, recently employed by the chamber, as manager of its industrial division.

V. E. Hulett, commercial manager, Oklahoma Power and Water Co., Sand Springs, presented details of employee information programs, now being conducted by his company. These include instruction in fundamental principles of government as well as in the operation of public utility properties.

There has been an insistent demand for the 1944 Gas Measurement Short Course to be held after temporary suspension last year, W. H. Carson, dean of the school of engineering, University of Oklahoma, at Norman, told attendants at the Gas Division meeting. He expects a good attendance and presence of manufacturers' exhibits at the school regardless of continuance of the war, he said. Dates stand at June 6, 7 and 8.

L. A. Farmer, president, Northern Oklahoma Gas Co., Ponca City, was elected chairman of the Gas Division, and S. I. McElhoes, director, Public Service Co. of Oklahoma, Tulsa, was elected chairman of the Electric Division, at the close of meetings of these sections.

E. C. Joullian, president, Consolidated Gas Utilities Corp., Oklahoma City, who was elected president of the Association at the beginning of this year, presided over the general session of the convention. George A. Davis, president, Oklahoma Gas and Electric Co., Oklahoma City, was elected vice-president of the Association to succeed George M. McLean, El Reno, recently deceased, Miss Kate Niblack, Association Secretary, announced. Attendance at the convention was about 200.

Program Announced for IOCC Spring Meeting

"Oil for Tomorrow," the Interstate Oil Compact Commission's educational film, will have its grand premiere before an audience of industry leaders and public officials at the Compact's spring quarterly meeting April 3-4 in the Roosevelt Hotel, New Orleans.

Other features on the program will include a paper on gas cycling operations, a source of high octane fighting gasoline and an important industry in Louisiana, by R. L. Keyes of New Orleans, assistant division manager of The Texas Co.; a discussion of Louisiana's modern oil and gas conservation law by George A. Wilson, former general counsel for the Department of Conservation, now director of PAW's Transportation Division, Washington; a demonstration of the administration of the law at an official public hearing to be conducted by Conservation Commissioner Joseph L. McHugh; and a description of problems destined to confront the states in the period following the cessation of the present world conflict, by Frank Bane of Chicago, executive director of The Council of State Governments.

Formal reports of the committees will be presented at the closing session.

Program Arranged for April SMCA Meeting

The Southern California Meter Association will hold its monthly dinner meeting at the Rio Hondo Country Club, Downey, at 6:30 p.m., Thursday April 20, 1944.

The program to follow the dinner will consist of a paper "A Review of the More Common Methods of Determining Specific Gravity of Gas," by Messrs. B. O. Cossey and B. C. Sanders, both of the Southern California Gas Co. Demonstrating models of specific gravity recorders will be on display for illustration of the evening's subject.

Want to be Surprised?

...THEN LEARN HOW LITTLE IT WILL COST TO RUSTPROOF ANY OF THESE POSTWAR HOMES

First of all, what would you guess to be the extra cost of rustproofing an average 6 or 7 room house including:

Anaconda Copper Tubes for both hot and cold water lines.

Copper for roof and chimney flashings, ridges and valleys.

Copper for rain gutters and downspouts.

Bronze Wire for screens.

Five hundred dollars? Three hundred dollars? Well, get set for a surprise! Because *two hundred dollars* will more than cover the extra cost of these durable metals... and in many houses of simplified design the extra cost might be even less than *one hundred dollars*.

And here is what you will get in return: Water pipe that cannot rust to stain the water or reduce the flow. Flashings and valleys that will give lasting roof protection against water leaks around chimneys, gables, etc. And screens, gutters and downspouts that can be depended on for years of trouble-free service.

When the red metal gets the green light...

Today, war needs get first call on all copper and brass. But when conditions permit, time-tested Anaconda Copper, Brass, Bronze will be ready for home builders in many forms of usefulness...including plumbing, sheet metal work, decorative trim and hardware of enduring service and economy.

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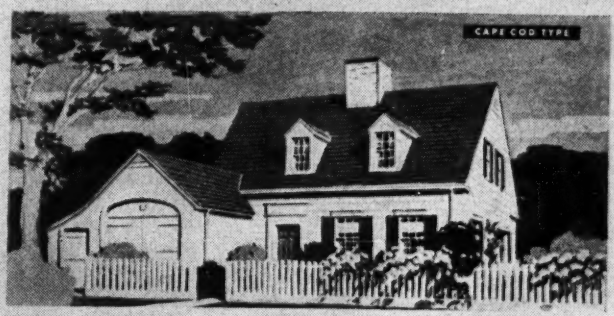

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... to know that the best of tomorrow's homes are being planned today. And Anaconda messages such as this in Better Homes and Gardens and American Home are pre-selling thoughtful people on rustproof hot water service... which includes, of course, a water heater with an Everdur* Metal tank.

You will find, when the time comes, that when you recommend Everdur to these preferred prospects, you are talking to people who want lasting, trouble-free equipment, people with whom the name "Everdur" will find ready acceptance. 4475

*Reg. U. S. Pat. Off.

Symposiums to Feature Natural Gas Meeting

TWO symposiums surveying important fields of natural gas operation will feature the program planned for the Natural Gas Department, American Gas Association conference to be held at French Lick Springs Hotel, French Lick, Indiana on May 11, 12 and 13.

The first will review modern trends in the storage of natural gas both by liquefaction and by underground storage. Company representatives from all sections of this country and Canada where these operations are in practice today will discuss this subject from the point of view of each company's experience.

It is probable that the following phases of underground storage will be considered: location of storage pools; area covered; name of horizon; depth; original rock pressure; number of active wells; number of input wells; size of tubing; present storage pressure; storage pressure as of December 1, 1943; gas stored underground December 1, 1943; gas now stored underground (May 1, 1944); volume of gas put in under certain pressure conditions; gas that may be withdrawn under certain conditions; horsepower in compressor station required for injecting or extracting gas; and water conditions.

Current experiences in the process of liquefaction and regasification will also be related.

The second symposium will center around the long distance transmission of natural gas. Companies who have engaged in transmitting gas over some distance will relate their experiences and discuss modern practices employed in pipeline construction and operation, compressor station operation and maintenance, dehydration and related problems.

There will be one general session over which the chairman of the Department and Vice President of the Association, J. French Robinson, will preside.

A feature speaker will be Dr. R. R. Sayers, Director of the Bureau of Mines with which the Department has cooperated over a period of years in research studies of mutual interest.

CP Range Campaign Display Contest

The Association of Gas Appliance and Equipment Manufacturers is sponsoring a contest designed to publicize the most effective window display built around the poster in the CP Gas Range Business Building Plan. First prize in the contest will be a $50 War Bond, second prize a $25 War Bond, with five honorable mentions.

Displays are to be built around the 25 x 38 in. 2-color CP poster illustrated on page 42 of the February issue of GAS, carrying out the theme of the current CP gas range campaign, "You Can Help Give Service Men Peacetime Jobs by Planning Now to Buy Your CP Gas Range with Extra War Bonds." Photographs of displays entered in the contest must be mailed on or before June 15.

Full details on the contest, and complete kits containing copies of the poster and other dealer helps, may be obtained from CP Gas Range Division, Association of Gas Appliance and Equipment Manufacturers, 60 East 42nd Street, New York 17, N. Y.

AGA Joint Production and Chemical Committee Meeting

F. J. Pfluke, Rochester Gas & Electric Corp., chairman of the Gas Production Committee, and V. J. Altieri, Eastern Gas and Fuel Associates, Everett, Mass., chairman of the Chemical Committee, announce that the program for the Joint Production and Chemical Committee Conference, to be held at the Hotel Pennsylvania in New York, N. Y. June 6 and 7, is well under way. Practical papers dealing with present and some post war problems along with four timely Round Table Luncheon Conferences have been arranged by A. C. Sedlachek of the Philadelphia Coke Co., Philadelphia, Pa., and Louis Shnidman of the Rochester Gas & Electric Corp., Rochester, N. Y.

Iowa Utilities Association Names New Officers

The Iowa Utilities Association has named B. F. Pickard, president of the Interstate Power Co., Dubuque, president of the Association, to succeed George A. Neal, Iowa Public Service Co., Sioux City, Iowa.

Other officers elected include: C. A. Leland, Iowa Power and Light Co., first vice-president; F. A. Fratcher, Central States Electric Co., Cedar Rapids, second vice-president; and William Blake, Des Moines, secretary manager. Mr. Blake is in charge of the Iowa Utilities Association office in Des Moines.

Midwest Industrial Gas Sales Conference Elects Officers

H. H. Feierabend, Northern Public Service Co., Gary, has been elected chairman of the Midwest Industrial Gas Sales Conference. Other new officers are: J. B. Druse, Milwaukee Gas Light Co., vice-chairman; and Paul F. Gibson, Western United Gas & Electric Co., Aurora, secretary.

New Quarters for Gas Gild

The Gild of Ancient Supplers of Gas Appliances, Skills, Gins, Accessories and Substances has moved to new quarters at 201 S. 42nd St., Philadelphia, Pa.

AGA Distribution Conference To Be Held in Cleveland

The Twenty-first Annual Distribution Conference of the Technical Section of the AGA will be held at the Hotel Statler in Cleveland on April 18 and 19.

Details of the program have not yet been announced, but A. C. Cherry, Cincinnati Gas & Electric Co., chairman of the Distribution Committee, reports that the program committee has prepared interesting and stimulating sessions on current and post-war matters.

The luncheon conferences are under the direction of T. H. Kendall, Equitable Gas Co., Pittsburgh, vice-chairman of the Distribution Committee. The two Tuesday afternoon luncheon conferences will merge at about 3:45 p.m. to participate in a discussion of a topic of vital interest to all operating men.

Members of the conference are cordially invited to inspect the facilities of the AGA Testing Laboratories in Cleveland on April 17 and 20 before and after the conference.

Calendar

April

Interstate Oil Compact Commission Spring Meeting—New Orleans, La., April 3-4.

Mid-West Gas Association—Fort Des Moines Hotel, Des Moines, Iowa, April 5.

National Association of Corrosion Engineers—Rice Hotel, Houston, Texas, April 10-11-12.

Midwest Power Conference, arranged by Illinois Institute of Technology—Palmer House, Chicago, Ill., April 13-14.

Natural Gasoline Association of America—Baker Hotel, Dallas, Texas, April 13-15.

AGA Distribution Conference—Hotel Statler, Cleveland, Ohio., April 18-19.

Missouri Association of Public Utilities—Jefferson Hotel, St. Louis, Mo., April 19-20.

May

Pennsylvania Gas Association Annual Meeting—Philadelphia, Pa., May 2.

17th National Oil and Gas Power Conference, Oil and Gas Power Division, American Society of Mechanical Engineers—Tulsa, Okla., May 8-10.

AGA Natural Gas Department Spring Meeting—French Lick Springs Hotel, French Lick, Ind., May 11-12-13.

Indiana Gas Association, 1944 Convention—Hotel Lincoln, Indianapolis, Ind., May 15-16.

American Petroleum Institute—Tulsa, Okla.

June

Southwestern Gas Measurement Short Course—University of Oklahoma, June 6-7-8.

AGA Joint Production and Chemical Committee Conference—Hotel Pennsylvania, New York, N. Y., June 6-7.

Public Utilities Advertising Association—Palmer House, Chicago, Ill., June 6-8.

Canadian Gas Association, Annual Meeting—Royal Connaught Hotel, Hamilton, Ont., Canada, June 8.

AGA Conference on the Operation of Public Utility Motor Vehicles—Hotel Bellevue-Stratford Philadelphia, Pa., June 27.

November

American Petroleum Institute—Stevens Hotel, Chicago, Ill., Nov. 13-16.

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PEOPLE

Marshall Newcomb

• President **D. A. Hulcy** of Lone Star Gas Co., Dallas, has announced the election by the company's board of directors of **Marshall Newcomb** to be general attorney of the company. He became an attorney for the company in 1928.

He has taken a prominent part in all of the company's important litigation, being one of the principal attorneys in the big Lone Star Gas Company gate rate case, one of the largest rate cases ever tried in Texas. This case went through the Texas appellate courts up to the United States Supreme Court and the company won substantial victories. He also took a lead in the company's Oklahoma rate cases in which the utility twice won in the Oklahoma Supreme Court. He was principal trial lawyer in the Wichita Falls rate case in which the company, for the second time, won a favorable jury verdict in a rate case.

• **Howard M. Thomas,** president and general manager of Northwest Cities Gas Co., Walla Walla, Wash., has retired. He will be succeeded by **Arthur J. Anderson** of Walla Walla. Mr. Thomas will continue as a director of the company.

• **Charles W. Stewart** has been appointed general foreman of the Gas Meter Shop of San Diego Gas & Electric Co., to fill the vacancy created by the death of **Otto Goldkamp.** Mr. Stewart has been working in the shop since 1921.

• **Norman F. Paxton,** assistant secretary and assistant controller of the Panhandle Eastern Pipe Line Co., Kansas City, Mo., has been elected to membership in the Controllers Institute of America.

• **O. F. Flummerfeld,** president of the Iroquois Gas Corp., Buffalo, N. Y., has been appointed to that city's committee to conserve critical resources. The committee will conduct a campaign, through the efforts of its consumer-group representatives, for the conservation of fuel in the Buffalo area .

J. Y. Wheeler

• **J. Y. Wheeler,** who founded the Washita Valley Gas Co., in Oklahoma in 1922 and sold out five years later to the Lone Star Gas Co., of Dallas, Texas, to become an employee of that utility, is back in Oklahoma as manager of the 27 natural gas distributing properties and pipe lines of the company.

After having served in the latter capacity in Oklahoma until 1940 he was sent by his company to El Paso, Texas as vice president and manager of the Lone Star properties there. He resumed his duties as manager of the Oklahoma properties on March 1, 1944. He was president of the Oklahoma Utilities Association in 1935 and for 10 years served as a member of the board of directors of that organization.

• The resignation of **Wirt Franklin** as special field assistant to Deputy Petroleum Administrator **Ralph K. Davies** was recently announced by the Petroleum Administration for War. Mr. Franklin joined the PAW in August of 1941.

• **Merle Thorpe,** editor of **Nation's Business,** has retired from the magazine and has been elected to the board of Cities Service Co., according to an announcement by **W. Alton Jones,** president of the company. Mr. Thorpe will also serve the company as director of business development.

Manufacturers

• **Robert J. Canniff,** manager of the advertising and sales promotion department of Servel, Inc., has announced the appointment of **Mrs. Virginia Hart** as Kitchen Planning Consultant to his department. In 1933 Mrs. Hart edited "Modern Kitchens, A Handbook of Design and Construction," for the American Gas Association; from 1934 to 1936 she was with the Consolidated Gas Co. of New York, organizing their kitchen planning service; and from 1937 to 1942 she was associate editor of **House and Garden,** in charge of home equipment.

• **R. J. Wood, Jr.,** formerly district sales manager, Jones & Laughlin Steel Corp., Tulsa, has been appointed manager of tube sales for Frick-Reid Supply organization in the Mid-Continent area, with headquarters in Tulsa. **S. R. Clinkscales,** last year in the Tulsa office of PAW, has returned to Frick-Reid as assistant district manager of tube sales. Other new district managers for the organization are **Henry J. McAdams** in the New York Office, **O. P. Watkins** in the Michigan district, and **T. L. (Dick) Lewis** in the Gulf Coast area, with offices in Houston, Tex.

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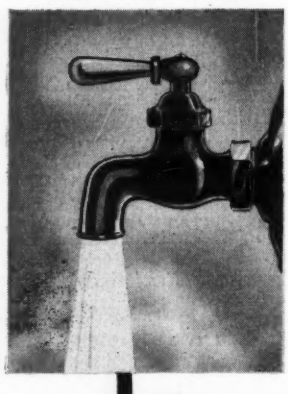

Domestic

Water Heater Thermostats

Safety Pilots-Room Thermostats

DOMESTIC THERMOSTAT CO., LOS ANGELES

• **J. E. Woodall,** home appliance sales manager at A. O. Smith Corp., announces the appointment of **Jim Donnelly** as sales manager of the Gas Water Heater Division. Mr. Donnelly assumed his new duties on March 1, and is making his headquarters at the A. O. Smith Corp. general offices in Milwaukee.

Jim Donnelly

Mr. Donnelly was formerly with the Bastian-Morley Co. Inc., La Porte, Ind. After serving this company as field representative for 10 years, he became advertising manager and later was appointed to the position of sales manager which he held for the last seven years.

Mr. Donnelly was chairman, Water Heater Division and member of Board of Directors, Association of Gas Appliance and Equipment Manufacturers, 1942 and 1943. He is currently chairman, Water Heater Marketing Committee, AGAEM, member of the American Gas Association Water Heating Committee and the O.P.A. Water Heater Industry Advisory Committee.

• **N. M. Barnett,** formerly manager of the Detroit office of Bailey Meter Co., has been appointed manager of the company's Chicago office, 1041 Marquette Building. His place in Detroit, at 226 Curtis Building will be filled by **Ralph T. Cowan,** a member of the Detroit and Cleveland sales offices of the company.

• General Controls Co., Glendale, Calif. has opened a new branch office at 376 Nelson Street, S.W., Atlanta 3, Ga., with **Roger W. Allen** as Branch Manager. The company manufactures pressure, temperature and flow controls; and factory sales and service to Atlanta customers will be under Mr. Allen's direction.

On Active Duty

• Promotion of Lt. Col. **Albert S. Johnson** of Dallas to full colonel has been announced by Major Gen. William Morris, Jr., commanding General of the XVIII Corps, Brownwood. Prior to being called to active duty, Col. Johnson was president of the Southern Union Gas Company in Dallas. He has been on leave from Southern Union since 1942.

• **William A. Adams, Jr.,** formerly distribution engineer for Arkansas-Louisiana Gas Co. in Little Rock, has been promoted from the rank of major to that of lieutenant colonel in the Army Air Corps. Colonel Adams joined the Army Air Corps in October of 1940.

Obituaries

• **Guy Luneau,** 46, Arkansas-Louisiana Gas Co. manager for Monticello and Warren, Ark., died suddenly on February 22 at his home in Monticello. Mr. Luneau had been with the company since 1925, and had been manager at Warren since 1930 and at Monticello since 1941.

• **John J. Barada,** 50, safety and employment director of the Laclede Gas Light Co., died March 11, following a heart attack. He had been a member of the company for 33 years, and was district chief of the National Committee of Manpower in War Industries, U. S. Department of Labor. A noted safety authority, he was for 12 years supervisor of the Company's inhalator squad.

• **Joseph P. Delaney,** 70, formerly with Union Gas and Electric Co., Cincinnati, Ohio, died in Los Angeles on February 23, after a short illness. Mr. Delaney has spent his entire life in the gas business, starting with Helme & McIlhenny Meter Co., Philadelphia; he was retired from Union Gas and Electric Co. in 1929. His father and several of his brothers were also gas men, as are his four sons, **J. Robert** and **Frank A.,** with Cincinnati Gas & Electric Co.; **Edward E.,** Municipal Gas, Light & Water Co., Memphis; and **J. J.,** Reliance Regulator Corp., Alhambra, Calif.

MEN ON A MISSION . . .

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CURRENT READING

The Use of Natural Gas Components in Refinery Operations—A. H. Boultbee. "California Oil World," 2nd Nov. issue, 1943, pp. 17, etc. The modern trend in petroleum refining involves the seperation of stocks into individual compounds or classes of compounds by blending directly into finished products or as raw materials for specific chemical processes. This trend is discussed from the point of view of its application to the present uses of natural gas and stabilized natural gasoline. The requirements for war have accelerated this trend in the direction of producing war material such as aviation gaoline, and this aspect is emphasized in the discussion. The dependence of the production of high-octane components for aviation gasoline on iso and normal butane from the natural gas is illustrated. The production of toluene and the possible production of chemicals and butadiene frm natural gas are briefly outlined.

Simplified Petroleum Chemistry and Physics as Applied to Lubricants and Fuels.—Published in 1943 by the Petroleum Educational Institute, Los Angeles, Calif. This book was compiled with the intention of acquainting non-technical individuals with the fundamentals of chemistry and physics as applied to the refining of petroleum. The subject matter is picturized and explained without the mention of chemical symbols and formulas, and a number of the phenomena of hydrocarbon physics and chemistry are compared with similar situations occurring in every-day life with which the layman is familiar. A table of the chemical structures of the various compounds mentioned in the text is appended.

Semiautomatic Pressure Control in Low-Pressure, Low-Temperature Laboratory Fractionation—D. R. Douslin and W. S. Walls. "Industrial and Engineering Chemistrv," Analytical Ed., Jan., 1944, pp. 40-42. This paper describes a control device developed in the Phillips Petroleum Co. laboratory from materials usually available, which provides a simplified means of semiautomatic control for low-pressure, low-temperature laboratory fractionating equipment, without sacrificing excellence of control or ease of operation. Its outstanding attributes are simplicity of construction and low cost. The device may be used with good results on either the standard low-temperature laboratory fractioning column or the Podbielniak Heli-Grid type; and if these two types of columns are connected to the same manifold, the control may be shifted from one column to the other simply by moving the nitrogen flask. No other changes in the pressure control mechanism are necessary. Described and illustrated.

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National Bureau of Standards Letter Circular LC-736, "Liquid Densities of Eleven Hydrocarbons Found in Commercial C_4 Mixtures,"—compiled by C. S. Cragoe. This 25-page booklet is the result of a study undertaken by the National Bureau of Standards, at the request of the Rubber Reserve Co., involving the preparation of a standard table of liquid densities of six C_4 hydrocarbons, occurring in feed stocks for 1,3-butadiene manufacture, for use in weight and volume conversions. In planning the study it was agreed: (1) to include two C_3 hydrocarbons, propane and propene, and two C_5 hydrocarbons, n-pentane and iso-pentane; (2) to calculate densities from equations, assuming that the sum of liquid and vapor densities is a linear function to temperature; (3) to prepare three separate tables in different units; and (4) to cover the temperature range —50° to 140° F. A limited number of copies of the circular are available, without cost, upon application to the National Bureau of Standards.

Oil Shale a Source of Petroleum Products—"California Oil World," 2nd Jan. issue, 1944, pp. 7, etc. This article reviews a few facts about American oil shale as a source of petroleum products. The following are some of the topics briefly discussed: What is oil shale?; Physical composition of oil shale; Chemical nature of the "oily" part of shale; Location of U. S. oil shales; Rocky Mountain oil shales; Recovery of oil from shale; The shale retort; Refining shale oil; Refining problems.

Economics of Combustion—E. L. Dennis. "Petroleum Refiner," Jan. 1944, pp. 23-31. This paper covers proper design of fuel systems, maintenance of same, possibilities of economies by use of waste heat recuperative equipment and proper selection of burner equipment. If every oil refinery will carefully study all furnaces now in operation and carry out the improvements that will conserve fuel in only those instances where the savings will pay a handsome return on the investment, they will have effected the greatest fuel saving of all time. At the same time a most splendid example will be set for other industries.

Phase Equilibria in Hydrocarbon Systems: Heat of Solution of Ethane and Propane—R. A. Budenholzer, B. H. Sage, and W. N. Lacy. "Industrial and Engineering Chemistry," Nov., 1943, pp. 1214-1220. Experimental measurements were made to determine the change in enthalpy involved when either ethane or propane is dissolved in a relatively non-volatile hydrocarbon oil. Comparison is made between results obtained from calorimetric determinations and those calculated from the volumetric behavior of the system.

Vapor-Liquid Equilibria of Natural Gas-Crude Oil Systems—M. B. Standing and D. L. Katz. "Petroleum Technology," Nov., 1943. 14 pp. Equilibrium data are reported on the composition and densities of coexistng vapor and liquid phases as a function of pressure and temperature for four hydrocarbon systems prepared from crude oil and natural gas. The data were observed over a range of pressures from 1000 to 8220 lb. per sq. in. and at temperatures ranging from 35° to 250° F.

Michigan Consolidated Forms New District

A new district within the Michigan Consolidated Gas Co. has been formed as of January 1, 1944, embracing the combined activities of their recently acquired properties formerly known as American Michigan Pipe Line Co., American Production Co., and Mecosta Pipe Line Co., and including also pipe lines, compressor stations, gas storage fields and certain other facilities. Headquarters of the new District, to be known as the "Production and Pipe Line District," will be at 47 Division Ave. N., Grand Rapids.

This District will constitute a source of natural gas supply and underground storage and furnish pipe line transportation of gas to the Company's Distribution Districts in Grand Rapids, Muskegon, Mt. Pleasant, Greenville, and Big Rapids.

The new District is under the overall charge of **Glenn R. Chamberlain,** first vice-president of the Company. **J. E. Spindle,** assistant general manager of the Grand Rapids District, will be manager of production and storage; **Dean W. Flowers,** general manager of the Muskegon District, will be manager of pipe lines and compressors; and **A. G. Schroeder,** assistant general manager of the Grand Rapids District and first assistant secretary of the Company, will be in general charge of the accounting of the new District.

Turner Valley Wastage Reduced 3 Billion Feet

Gas wastage in Alberta's Turner Valley was reduced approximately three billion cu. ft. during 1943 as compared with the previous year, according to a February report from the Natural Gas & Petroleum Conservation Board in Calgary. Wastage for the past year was 20,932,037 Mcf. This was more than twice the amount turned into the Calgary Gas Company's Calgary-Lethbridge system, which used 9,409,810 Mcf. Imperial Oil Refinery at Calgary used 1,596,224 Mcf., while 53,533 Mcf. was forced back into the Bow Island field for storage and 12,248,538 Mcf. was used in Turner Valley as fuel.

FPC Publishes Report on Natural-Gas Companies

As a part of the Federal Power Commission's administration of the Natural Gas Act, the Commission has published an 87-page report containing financial and operating information on 118 gas companies. The companies included in the report were limited to those which have been determined to be natural-gas companies within the meaning of the Natural Gas Act.

The book investment in gas plant reported by the 118 companies showed an aggregate of $1,759,882,373 as of December 31, 1942.

Natural Gas Taxes in Texas Produce Increased Revenue

According to the report of George H. Sheppard, state comptroller in Texas, the natural gas production taxes in that state in 1943 yielded $2,701,605, an increase over 1942 of over $300,000. This increase of some 14% is accounted for by greater production and higher prices for gas. The amount collected from the 35 cycling plants, $653,706, was a material factor in the increase.

Wailes Dove-Hermiston Corp. Constructs Texas Plant

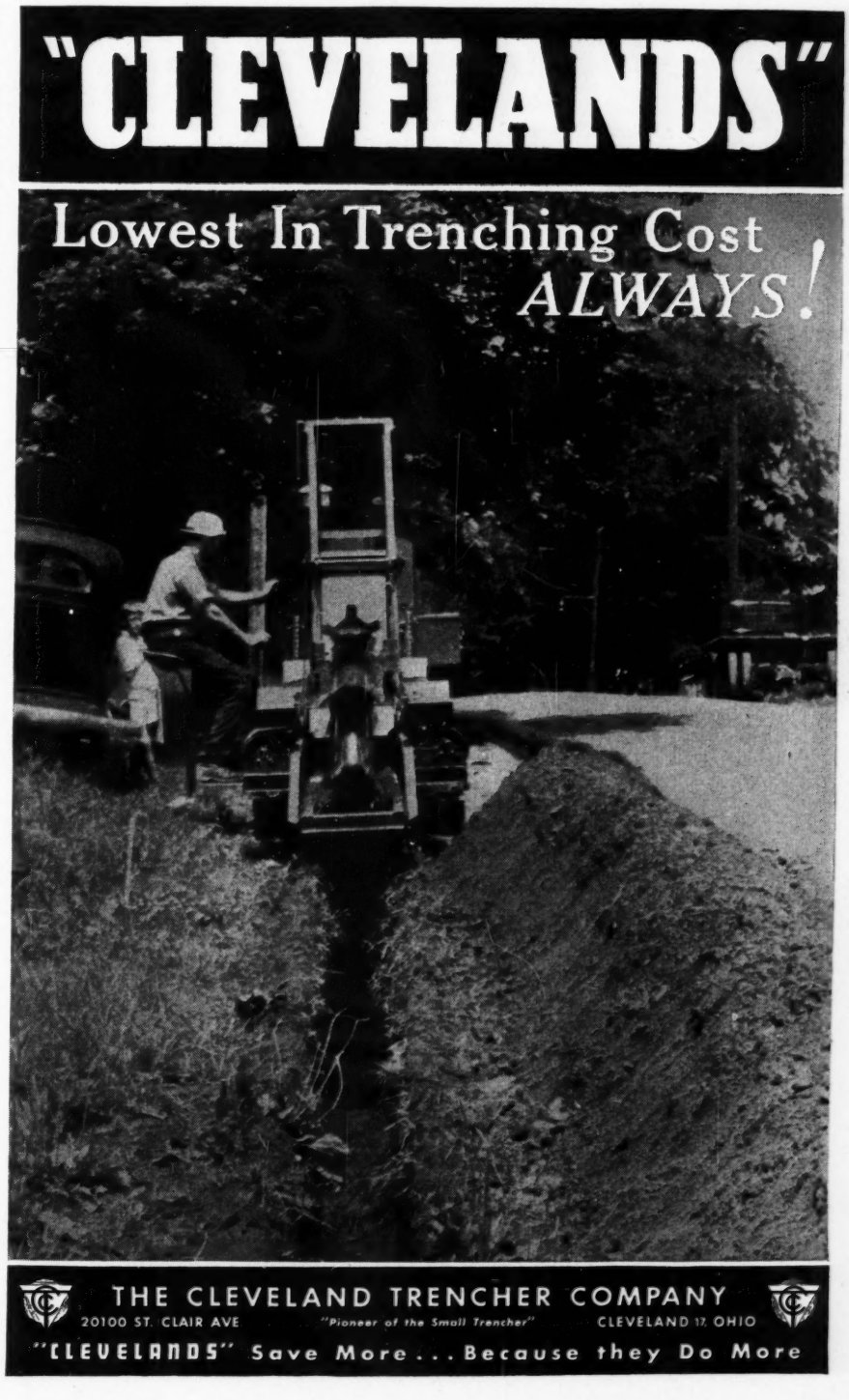
Wailes Dove-Hermiston Corp., Westfield, N. J. is constructing a new plant at Houston, Texas, to supply the needs for bitumastic pipe coating in the southwestern states. The plant is located at 7002 Clinton Drive, Houston, near the Beaumont Highway.

The first shipments of bitumastic priming solution and XXH enamel will be made for the protection of the Tennessee Gas and Transmission Co. pipe line now under construction.

Canadian Expansion of Norge Division, Borg-Warner

Norge division of Borg-Warner Corp. has completed arrangement for the manufacture in Canada of a complete line of Norge products, according to Howard E. Blood, president. Addison Industries, Ltd., of Toronto, will produce Norge refrigerators, washers, ranges, heating units and other appliances.

It is expected that the manufacture of Norge products in Canada will begin immediately after the war ends. Their distribution will be handled by Cross & Co., Ltd., of Toronto, which has branches throughout the Dominion. Norge products distributed in Canada before the war were made in America.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PIPE LINE CONSTRUCTION

• The much discussed $50,000,000 gas line between the Kansas Hugoton field and Southern California has been put on the shelf until after the war, according to Washington news reports.

• **Kansas-Nebraska Natural Gas Co., Inc.,** is proposing to build an 18-in. .250 wall thickness pipe line from its existing Scott City compressor station southwestwardly into the north end of the Hugoton gas field, a distance of some 40 miles, to a point about five miles southwest of Deerfield, Kans. It also proposes to build a 114-mi. line from the Scott City compressor station to the Stockton, Kans. compressor station, via Wakeeney, Kans., at which point an interconnection will be made for serving Central Gas Utilities Co. Of this line 100 miles will be 12¾ in. .250 wall thickness pipe, and the balance of 8 5/8 in. .219 wall thickness pipe.

The first line will be operated at field pressure (c. 350 lb.); the other will be built for an evenutal 800-lb. operating pressure, although it is expected that the need for the next few years will be for about 600 lb.

Construction of these lines is being made necessary by the approach of the Otis field to exhaustion. It is expected that construction will start shortly, and will be completed by September.

Compression and dehydration facilities of the Scott City station are also being expanded. Four 500 hp. engines are to be added to the compressor plant, and the existing glycol dehydration plant is to be expanded to have adequate capacity for treating the additional amounts of gas which will be passing through the station.

• Application has recently been made by **Panhandle Eastern Pipe Line Co.,** Kansas City, Mo., for permission to construct and operate additional natural gas pipe lines from its Calhoun County line in western Michigan to points near the city limits of Albion, Mich. The projects include a 2-in. line 1¼ miles long to **Albion Gas Light Co.** for domestic distribution in Albion; and a 2.7-mile 3½-in. line to the Albion Malleable Iron Co.

• **Memphis Natural Gas Co.** has applied to the FPC for permission to construct and operate an 18-in. loop line some 61 miles long which will parallel the company's present natural gas line in Chicot County, Ark., and Bolivar, Coahoma and Tunica counties, Miss., with tie-ins and appurtenant facilities.

• WPB has given approval to a 104-mile pipeline between the La Goleta dry gas field and the Los Angeles metropolitan area. The $4,000,000 carrier will be jointly constructed by **Southern Counties Gas Co., Southern California Gas Co.,** and **Pacific Lighting Corp.** (See Page 47).

• **Cities Service Transportation & Chemical Co.** has completed its 230-mile 26-in. natural-gas line from Guymon to Blackwell, Okla. Runs were expected to begin late in March. Meantime, construction was being rushed on a hydration plant and camp for employees near Guymon, in Texas County.

PRODUCTION AWARDS

• The Cooper-Bessemer Corp., Mount Vernon, Ohio, and Grove City, Pa., is to be awarded the Army-Navy "E." The company had received the Maritime Commission's "M" burgee in December of 1942 for outstanding production of diesel engines and major engine parts, and has subsequently received two gold stars for continued achievement—in August of 1943 and January of this year.

• The Bristol Co. of Waterbury 91, Conn., manufacturers of industrial control instruments and mill supplies, recently received the first star for their Army-Navy "E" burgee, signifying renewal of the production award for the next six months.

In addition to recording and control instruments and mill supplies for war industry, The Bristol Co. manufactures special devices for the Army and Navy.

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NEW GAS PRODUCTION

• Standard Oil Co. has completed well No. 67-17E, approximately one mile south of the southerly producing limits of the Coalinga field, Calif. The well blew at an initial rate of 3500 Mcf. of dry gas, through a 40/64 in. bean with 580 lb. tubing pressure and 950 lb. casing pressure. It is now standing shut in with a pressure of 1100 lb. on both tubing and casing.

• Recent gas discoveries on a 30,000-acre tract a few miles north of Kane, Pa., have increased drilling activities on the tract to the extent that at least 10 new wells are definitely in prospect. Opening of this field is expected to provide relief from a shortage of natural gas recently experienced in that area.

• The Oil and Gas Development Co., Ltd. was scheduled to begin drilling the first gas well of this year in the Unity field, in the Muddy Lake area, early in March, according to **Clarence O. Brown,** vice-president and managing-director of Franco Oils, Ltd., of which the former company is a subsidiary. The company expects to drill from three to seven wells, and to set up distributing headquarters in Saskatoon as soon as production of gas is assured. It is planned to pipe the gas to Saskatoon as soon as piping equipment is available.

• First natural gas producer of 1944 in Michigan was recently found in Norwich Township, Newaygo County, by Michigan oil operators completing a half-dozen wildcat tests as dry holes.

• Kentucky-West Virginia Gas Co. completed 5,509 John R. Burchett, on Cow Creek in Floyd County at 1,419 ft. in Big lime, with a daily open flow of 355,000 cu. ft. of gas.

• According to a late February report from Moundsville, W. Va., a 1,100,000 cu. ft. gas well has been brought in on Taylor Ridge, Marshall County, and there is talk of a new gas boom in the area. M. L. McCullough, Cambridge, O., has filed a lease covering 1351 acres and additional development is expected before the end of May. The Taylor Ridge well is reported by Dinsmore and Tedrow, Pennsylvania gas operators.

• A show of approximately 1,500,000 cu. ft., of natural gas daily was made in the No. 1 Moss Homestead well, west of Granite, Okla. It apparently brought in a new gas pool in southwestern Okla.

• A new gas pool was opened in Lincoln County, Okla., by Northern Ordnance, Inc., through a well drilled to 4093 ft., which tested an estimated 7,000 Mcf. per day with 1175 lbs. shut-in-pressure.

• A new gas horizon appears to have been opened by Hope Natural Gas Co. in Wood County, W. Va., with a good volume of gas. At 3088 ft. the gage showed 3,200,000 cu. ft. of gas.

• Completion of three gas wells in eastern Kentucky, with operations at a slightly lower level, was announced recently. Several other wells are near completion depth, and will be shot soon.

• Natural gas for domestic purposes may be made available shortly at Dawson Creek, British Columbia, eastern terminus of the Alaska Highway. An official of the Border Oil & Gas Co. announced recently that Premier John Hart of British Columbia has expressed willingness to grant permission to the company to pipe gas to Dawson Creek from wells on the Alberta side of the border, provided the company agrees to carry out a search for natural gas in British Columbia.

Some fields already have been discovered in the Dawson Creek area, although not sufficiently large as yet for commercial use. The company spokesman says the project will cost approximately $200,000 and that the cost to the consumer has been set tentatively at 60 cents per Mcf.

Louisiana Rapidly Depleting Its Gas Reserves

According to a statement made by P. A. Frye, secretary and executive officer of Louisiana Public Service Commission, at a recent meeting of Rotary Club, Louisiana's reserves of natural gas are being depleted at the rate of "about ½ trillion cu. ft. annually." Unless additional reserves are found, he predicts that the state's reservoirs of natural gas will be exhausted within about 20 years.

Save { GAS, MANPOWER, CRITICAL MATERIALS, TIME, MONEY }

with Carboseal Anti-Leak

Carboseal Anti-Leak saves gas by stopping leaks in the bell-and-spigot joints of dry-gas systems. The liquid compound swells the joint packing and stops the leaks. Reductions of 100 per cent in joint leakage are common. Reports show that joints in mains treated seven years ago are still tight.

Carboseal Anti-Leak saves manpower in two ways. First, only a small crew is required to apply it. And, second, service calls due to dust trouble are reduced, because the Anti-Leak thoroughly wets the main and lays the dust.

Carboseal Anti-Leak saves critical materials, largely eliminating the steel and rubber necessary for other methods of leakage control.

Carboseal Anti-Leak saves time. Its application by gravity flow inside the mains requires an average of four filling connections to the main per mile—excavation and repaving are almost eliminated.

Carboseal Anti-Leak saves money. The average cost of the Anti-Leak treatment is about 50 cents per joint, a fraction of the cost of leakage correction by other means.

For additional information, write for the book, "Correcting Leakage in Gas Distribution Systems with CARBOSEAL Anti-Leak."

CARBIDE AND CARBON CHEMICALS CORPORATION

Unit of Union Carbide and Carbon Corporation

30 East 42nd Street UCC New York, N. Y.

"Carboseal" is a registered trade-mark of Carbide and Carbon Chemicals Corporation.

PRODUCERS OF SYNTHETIC ORGANIC CHEMICALS

WAR ADVERTISING

A FACTUAL REPORT

The P. C. G. A. Cooperative Advertising Committee, like individual gas companies, has converted much of its space to support of the war effort.

During the past 23 months, 20 domestic advertisements (full pages in color) have featured war subjects, with 12, or 60 per cent, of these devoted almost wholly to such government-favored projects as War Bonds, fuel conservation, Red Cross, nutrition and care of appliances.

Of the 89 advertisements—domestic and trade journal—published by the Committee during this period, 24 featured war projects, and 32 included War Bond or other war-supporting messages.

THE PACIFIC COAST GAS ASSOCIATION

GAS FUEL

SERVING THE WEST IN WAR AND PEACE

Servel, Inc. Holds Air Conditioning Schools

As a part of its post-war action program on the "All-Year Gas Air Conditioner," Servel, Inc. has been holding week-long training schools at the factory for application, service and sales engineering representatives of gas utility companies from all over the country. These "schools"—four in all—were planned so that each covered one of the following phases of the program: (1) service problems; (2) application, installation, and servicing of the new unit; (3) sales problems; (4) further service problems.. The purpose of the series of schools is to prepare men to form skeleton sales and service staffs throughout the nation.

Servel's air conditioning program for the post war era has also included a series of meetings in New York, Atlanta, Chicago, Kansas City, Los Angeles, and San Francisco to introduce the company's plans for the post war future of gas air conditioning, and a series of regional meetings for gas company executives. It is expected that eight of these meetings will be held on the West Coast during April.

WEST COAST RANGE REPRESENTATIVE AVAILABLE NOW

20 years experience utilities and dealers in California, Arizona and New Mexico. Excellent record and references. Ray Jewell, 2227 East Villa Street, Pasadena, California.

Yes, We're Still Making Time-Tested Mono-Cast Centrifugal Pipe

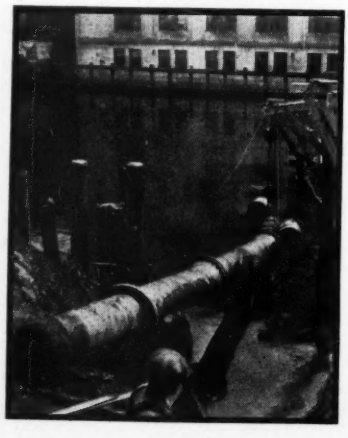
Under suitable priorities, of course. Fittings also available.

NOTE: Foresighted managers are planning now to replace substitutes with Cast Iron Pipe at war's end.

American Cast Iron Pipe Company

BIRMINGHAM, ALABAMA

Sales Offices in Principal Cities



Washington Orders

Petroleum Production: Handling of delivery orders for controlled materials required by petroleum producers will be expedited by the elimination of PAW Form 35 from the provisions of Preference Rating Order P-98-b, the Petroleum Administration for War announced March 18. No approval is required on controlled materials delivery orders costing less than $2500 and having no single item costing more than $500. P-98-b assigns allotment symbol P-1 for use on these delivery orders.

Stoves: Dealers in the Far West are given an increase in their allowable inventory of coal or wood heaters equal to 50% of their initial inventory allowance, and an increase of 100% in their allowable inventories of oil and gas heaters, effective March 25, OPA rules

Cast Iron Pipe: The WPB grants permission to produce extra-heavy cast iron soil pipe to replace "victory weight" pipe which has been manufactured since June 1, 1942. (Schedule 4 to Order L-43, as amended), issued March 15.

Cooking and Heating Appliances: (Order L-23-C, as amended), issued March 24. WPB removes restrictions limiting the weight of iron and steel permitted in domestic cooking appliances and domestic heating stoves, and removes restrictions prohibiting the use of alloy steel in these products.

Miller, Deaton and Frost Honored by Ickes

Secretary of the Interior Harold L. Ickes recently granted Awards of Excellence to three members of the Petroleum and Natural Gas Division of the Bureau of Mines: Harold C. Miller, senior petroleum engineer, Oakland, Calif.; William M. Deaton, senior chemist, Amarillo, Tex.; and Ellis M. Frost, Jr., chemical engineer, Shiprock, N. M.

The work of the latter two men is of especial interest to the gas industry. The war has limited the construction of new pipe lines for natural gas, but likewise has caused an enormous increase in demands for the fuel. As a result, existing lines are operated at higher pressures and the danger of gas hydrate thus has grown. These chemical compounds of natural gas and water formed under pressure, produce ice-like constrictions that decrease or even stop the flow of gas. Messrs. Deaton and Frost developed a simple, practical, and reliable device that determines the temperature at which natural gas will condense under pressure. Gas transmission companies now are able to make frequent tests of the efficiency of gas dehydration plants in removing water vapor from gas before it enters the pipe lines, thus avoiding serious interruptions.

Electronics Course Presented

A ten-lecture course in the theory and application of electronic devices as they affect utility operations is being conducted by the Allis-Chalmers Co. in March, April, and May in the Public Service Building in Milwaukee.